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# **COMMONWEALTH of VIRGINIA**

## **A BIOLOGICAL SURVEY OF THE COASTAL PLAIN DEPRESSION PONDS (SINKHOLES) OF COLONIAL NATIONAL HISTORICAL PARK, YORKTOWN, VIRGINIA**

### **FINAL REPORT**

Submitted to:  
National Park Service  
Colonial National Historical Park

Virginia Department of Conservation and Recreation  
Division of Natural Heritage  
Natural Heritage Technical Report 01-9  
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**A BIOLOGICAL SURVEY OF THE COASTAL PLAIN DEPRESSION  
PONDS (SINKHOLES) OF COLONIAL NATIONAL HISTORICAL PARK,  
YORKTOWN, VIRGINIA**

Natural Heritage Technical Report 01-9

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Dick and Shelly Franz assisted with zoological fieldwork in February 2000.

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## INTRODUCTION

In late 1998, the National Park Service, Colonial National Historical Park (CNHP), contracted the Virginia Department of Conservation and Recreation's Division of Natural Heritage (DCR-DNH) to conduct a two-year interdisciplinary investigation into the ecology and biota of the sinkhole ponds, or Coastal Plain Depression Ponds, a rare and threatened seasonal wetland community group, of Colonial National Historical Park. These ponds within CNHP are part of a larger complex of Coastal Plain Depression Ponds known as the Grafton Ponds Complex; ponds that have been surveyed in this complex outside CNHP support seven species of rare plants and animals in addition to significant natural community occurrences (Rawinski 1997, DCR-DNH database). They have been found to provide habitat also for regionally uncommon amphibians, odonates, and other invertebrates. The survey was designed to evaluate the 35 sites designated as potential "sinkhole ponds" in a map generated by the Virginia Institute of Marine Science (VIMS) for the US Environmental Protection Agency (EPA) (Figure 2). For each site found to contain a pond, data would be collected on vegetation communities, rare, threatened, and endangered plant and animal species, soils, non-rare plant and animal species, and invasive plant species. The data collected in this survey will be used to develop a comprehensive management plan for the significant Coastal Plain Depression Ponds of CNHP.

The Virginia Department of Conservation and Recreation's Division of Natural Heritage (DCR-DNH) is the state agency responsible by statutory authority under the Virginia Natural Area Preserves Act (Section 10.1-209 through 217, Code of Virginia) for inventory, database maintenance, protection, and management of Virginia's natural heritage resources. Such resources are defined as the habitats of rare, threatened, or endangered plant and animal species, rare or state significant communities, and other natural features. The Division represents the first comprehensive attempt to identify the Commonwealth's most significant natural areas through ongoing scientific biological survey.

Data gathered during the state-wide surveys are assembled and managed through a sophisticated Biological and Conservation Data System (BCD) in which information on ecosystems and species, their biology, habitats, locations, conservation status, and management needs is continually updated and refined. DCR-DNH is part of an international network of Natural Heritage Programs, coordinated by the Association of Biodiversity Information (ABI), which uses standardized inventory methodologies and BCD technology developed by The Nature Conservancy (TNC).

## Study Area

### Physical Environment

The study area lies within Colonial National Historical Park, on Virginia's Lower Peninsula at 37° 11' to 15' latitude and 76° 29' to 33' longitude, southeast, south, and southwest of Yorktown, in York County, Virginia (Figure 1). The National Park Service manages the Parklands to preserve its historical and natural resources. The Coastal Plain Depression Ponds/Sinkhole Ponds that occur on CNHP property are a significant natural resource and are part of the notable Grafton Ponds Complex that continues south of CNHP. Together these wetlands are the best remaining example of a coastal plain seasonal pond/depression pond complex.

The study site is located in the southern coastal plain physioprovince, a rolling plain composed of unconsolidated sands, gravels and clays eroded from the Appalachian highlands to the west and deposited on the continental margin (Fenneman 1938). The geology of the Colonial Depression/Sinkhole/Seasonal Ponds has been mapped as the Chuckatuck Formation (Rader and Evans 1993). This formation consists of surficial deposits of riverine, estuarine, and coastal terraces and plains dating back to the middle Pleistocene. Soils are classified as the Bethera-Izagora-Slagle series characterized as "deep, poorly drained and moderately well-drained soils that dominantly are clayey or loamy and are nearly level to gently sloping; on flats and in depressions on uplands" (Hodge et al. 1985.). Elevations for the ponds range from 12 to 21 meters (40 to 70 ft.). Research on the geologic record of the Grafton Ponds indicated

that these ponds are “sinkhole features up to 800,000 years in age which have been slowly subsiding over the past several hundred thousand years due to the dissolution of the underlying carbonate-rich shell marl deposits” (Rawinski 1997). Virginia’s Lower Peninsula experiences hot summer and cool winters. The average annual temperature, as reported for Norfolk over the decade of 1990-2000, was 60.0 ° F, and precipitation levels for 1999 and 2000 were 55.39 inches and 61.42 inches, respectively (National Climatic Data Center 2001). Water levels in the ponds are very much influenced by annual climatic conditions and the vegetation, in turn, is influenced by the water levels.

### Natural Environment

The major vegetation immediately surrounding the natural ponds (Ponds 15, 46, 55, 62 , and 63) is best characterized as Mixed Oak/Heath Forest (Fleming et al. 2001). Common canopy species include southern red oak (*Quercus falcata*), loblolly pine (*Pinus taeda*), white oak (*Quercus alba*), and scarlet oak (*Quercus coccinea*). Red maple (*Acer rubrum*), flowering dogwood (*Cornus florida*), and black gum (*Nyssa sylvatica*) are typical in the subcanopy. The understory is typically sparse, with blueberries (*Vaccinium* spp.) and huckleberries (*Gaylussacia* spp.) contributing the most significant cover. True herbs are very sparse, but may include Christmas fern (*Polystichum acrostichoides*), striped wintergreen (*Chimaphila maculata*), and partridge-berry (*Mitchella repens*). A complex of seasonal wetlands (42, 43, 44, 45, 47-48) is situated within a field designated by CNHP as Field 10, located west of Route 17 and north of the Historical Tour Drive. This field, including the cluster of seasonal wetlands within, is normally mowed, obscuring the species composition, but if allowed to grow up over a growing season would undoubtedly be dominated outside of the wetlands by a mix of grasses, including exotics such as Bermuda grass (*Cynodon dactylon*), velvet-grass (*Holcus lanatus*), and sweet vernal grass (*Anthoxanthum odoratum*), and natives, prominently broomsedge (*Andropogon virginicus*).

In addition to the depression ponds, CNHP also has some significant communities that result from the incision of ravines and slopes into the underlying calcium-rich shell marl. Additional survey work conducted on several of these areas in 2000 is discussed in Appendix I .

## **METHODOLOGY**

### **Explanation of the Natural Heritage Ranking System**

Each of the significant natural features (species, community type, etc.) monitored by DCR-DNH is considered an element of natural diversity, or simply an **element**. Each element is assigned a rank that indicates its relative rarity on a five-point scale (1 = extremely rare; 5 = abundant; Table 1). The primary criterion for ranking elements is the number of occurrences, i.e., the number of known distinct localities or populations. Also of great importance is the number of individuals at each locality or, for highly mobile organisms, the total number of individuals. Other considerations include the condition of the occurrences, the number of protected occurrences, and threats. However, the emphasis remains on the number of occurrences, so that ranks essentially are an index of known biological rarity. These ranks are assigned both in terms of the element's rarity within Virginia (its State or S-rank) and the element's rarity over its entire range (its Global or G-rank). Subspecies and varieties are assigned a Taxonomic (T-) rank in addition to their G-rank. Taken together, these ranks give a concise picture of an element's rarity. For example, a designated rank of G5/S1 indicates an element which is abundant and secure range-wide, but extremely rare in the state. Ranks for community types are provisional, or in many cases lacking, due to ongoing efforts by the Natural Heritage network to classify community taxa. These global and state rarity ranks used by DCR-DNH are not legal designations, and they are continuously updated to reflect new information.

**Table 1. Definition of Natural Heritage state rarity ranks.** Global ranks are similar, but refer to a species' range-wide status. Note that GA and GN are not used and GX means extinct. Sometimes ranks are combined (e.g. S1S2) to indicate intermediate or somewhat unclear status. Elements with uncertain taxonomic validity are denoted by the letter Q, after the global rank. Ranks for most community types have not been generated due to ongoing community classification efforts. These ranks should not be interpreted as legal designations.

- S1 Extremely rare; usually 5 or fewer occurrences in the state; or may have a few remaining individuals; often especially vulnerable to extirpation.
- S2 Very rare; usually between 5 and 20 occurrences; or few occurrences with many individuals; often susceptible to becoming endangered.
- S3 Rare to uncommon; usually between 20 and 100 occurrences; may have fewer occurrences, but with a large number of individuals in some populations; may be susceptible to large-scale disturbances.
- S4 Common; usually more than 100 occurrences, but may be fewer with many large populations; may be restricted to only a portion of the state; usually not susceptible to immediate threats.
- S5 Very common; demonstrably secure under present conditions.
- SA Accidental in the state.
- SH Historically known from the state, but not verified for an extended period, usually more than 15 years; this rank is used primarily when inventory has been attempted recently.
- SN Regularly occurring migrants or transient species which are non-breeding, seasonal residents. (Note that congregation and staging areas are monitored separately).
- SU Status uncertain, often because of low search effort or cryptic nature of the element.
- SX Apparently extirpated from the state
- S\_? Rank uncertain

The spot on the landscape that supports a natural heritage resource is an **element occurrence**. Occasionally, separate but nearby locations of a species or community element are treated as subpopulations (species) or sub-occurrences (community) of the same occurrence due to factors such as the probability of gene flow or hydrologic linkage. Information on the location and quality of these element occurrences is computerized within the BCD system, and additional information is recorded on maps and in manual files.

In addition to ranking each element's rarity, each element occurrence is ranked to differentiate large, outstanding occurrences from small, vulnerable ones. In this way, protection efforts can be aimed not only at the rarest elements, but at the best examples of each. Species occurrences are ranked in terms of quality (size, vigor, etc.) of the population; the condition (pristine to disturbed) of the habitat; the viability of the population; and the defensibility (ease or difficulty of protecting) of the occurrence. Community occurrences are ranked according to their size and overall natural condition. These **element occurrence ranks** range from A (excellent) to D (poor). Sometimes these ranks are combined to indicate intermediate or somewhat unclear status, e.g. AB or CD, etc. In a few cases, especially those involving cryptic animal elements, field data may not be sufficient to reliably rank an occurrence. In such cases a



rank of E (extant) may be given. Element occurrence ranks reflect the current condition of the species' population or community. A poorly-ranked element occurrence can, with time, become highly-ranked as a result of successful management or restoration.

Element ranks and element occurrence ranks form the basis for ranking the overall significance of sites. Site **biodiversity ranks** (B-ranks) are used to prioritize protection efforts, and are defined as follows:

- B1 Outstanding Significance: only site known for an element; an excellent occurrence of a G1 species; or the world's best example of a community type.
- B2 Very High Significance: excellent example of a rare community type; good occurrence of a G1 species; or excellent occurrence of a G2 or G3 species.
- B3 High Significance: excellent example of any community type; good occurrence of a G3 species.
- B4 Moderate Significance: good example of a community type; excellent or good occurrence of state-rare species.
- B5 General Biodiversity Significance: good or marginal occurrence of a community type or state-rare species.

Note: sites supporting rare subspecies or varieties are considered slightly less significant than sites supporting similarly ranked species.

## **Explanation of Federal and State Categories**

The U.S. Fish and Wildlife Service (USFWS) is responsible for the listing of endangered and threatened species under the Endangered Species Act of 1973, as amended. Federally listed species (including subspecific taxa) are afforded a degree of legal protection under the Act, and, therefore, sites supporting these species need to be highlighted. USFWS also maintains a review listing of potential candidate endangered and threatened taxa. Table 2 defines the various status categories used by USFWS and followed in this report. The status category of candidate species is based on the Service's current level of knowledge about the biological vulnerability of and threats to a species.

**Table 2. U.S. Fish and Wildlife Service species status codes, with abbreviated definitions.**

LE Listed endangered

LT Listed threatened

PE Proposed to be listed as endangered

PT Proposed to be listed as threatened

C Candidate (formerly category 1): status data supports listing of taxon as endangered or threatened, but listing has been delayed by pending proposals of higher priority taxa.

In February 1996 the US Fish and Wildlife Service revised its categories for the candidate list in the following manner: Taxa formerly considered as 'Category 1' candidates for listing are now considered as 'Candidate'. Taxa formerly considered as 'Category 2' (C2) candidates are no longer being maintained by the Service as Candidate or Status Review taxa. The Service has suggested that such taxa be

considered as ‘Species of Concern’ (SOC) or ‘Species at Risk,’ neither of which has official status. The Virginia Field Office of the US Fish and Wildlife Service maintains a list of these SOC, which includes all taxa globally ranked as G1-G2 (Eric Davis, pers. comm.). Taxa formerly considered as ‘Category 3’ candidates are no longer being maintained by the Service. This included taxa for which the Service had persuasive evidence of extinction (3A); that did not represent distinct entities meeting the Act’s definition of ‘species’ (3B); or that had proven to be more abundant or widespread, or not subject to any identifiable threat (3C).

In Virginia, two acts have authorized the creation of official state endangered and threatened species lists. One act (section 29.1-563 through 570, Code of Virginia), administered by the Virginia Department of Game and Inland Fisheries (DGIF), authorizes listing of fish and wildlife species, not including insects. The Endangered Plant and Insect Species Act, (section 3.1-1020 through 1030, Code of Virginia), administered by the Virginia Department of Agriculture and Consumer Services (VDACS), allows for listing of plant and insect species. In general, these acts prohibit or regulate taking, possessing, buying, selling, transporting, exporting, or shipping of any endangered or threatened species appearing on the official lists. Species protected by these acts are indicated as either listed endangered (LE) or listed threatened (LT). Species under consideration for listing are indicated as candidates (C). In addition DGIF has created an informal category of Special Concern (SC) for animals that merit special attention; this is an unprotected status.

## **Overview of Natural Heritage Inventory Methodology**

Staff of the Virginia Department of Conservation and Recreation's Division of Natural Heritage (DCR-DNH) approach natural heritage inventories in a systematic manner. This inventory of the coastal plain depression ponds of Colonial National Historical Park was conducted in 5 basic stages:

1. Review of aerial photographs and maps. Aerial photographs of the entire survey area were reviewed to identify the potential seasonal wetland areas delineated on the VIMS map.
2. Review of existing information. Museum collections were visited by DCR-DNH staff, and specimen label information was recorded for rare species. Published and unpublished information on natural areas within the inventory area was collected and assimilated in conjunction with review of aerial photographs. Maps of lands within the survey area were gathered, BCD databases were accessed, and the known distribution of natural heritage resources was examined.
3. Initial ground survey. Initial ground reconnaissance was conducted in targeted sites. During this stage, land use activities were assessed, conspicuous element occurrences were documented and follow-up visits were planned.
4. Thorough inventory of the site. During this stage, detailed information was collected on the rare species and exemplary natural communities present at a site. The area of land needed to protect the special biological features was determined. Threats and past or present disturbances were also evaluated. Element occurrence data were transcribed onto USGS quadrangle maps and entered into DCR-DNH’s Biological and Conservation Data (BCD) system. Throughout this inventory, continual communication between project team members (botanists, zoologists, and ecologists) was emphasized to ensure that all significant natural areas were visited by appropriate specialists and that data was coordinated. In addition, some flexibility is built into the process so that priorities can be adjusted when unexpected elements are encountered.
5. Compilation of results and preparation of final report. As field work was completed, Natural Heritage biologists reviewed the information gathered and ranked sites according to their ecological significance.

Maps were drawn showing preliminary conservation planning boundaries, and protection and management recommendations were written. These were combined with site reports and other required information in preparing a final report.

## Specific Survey Objectives

Overall objectives of this survey, as specified in the Contract, included the following:

- Provide ground-truthed data to update the Park's GIS sinkhole database.
- Digitally photograph the ponds, general habitat conditions, and rare, threatened, endangered and DCR-DNH watchlisted species.
- Analyze soil properties of the ponds including pH, element levels, and color.
- Inventory for rare, threatened, and endangered, (DCR-DNH rank of G1-G3 or S1-S3) plants and animals and watchlist (rank of S3 and SU ) species found in the sinkholes or observed in area.
- Provide a complete list of plants species encountered in each of the ponds.
- Map the distribution of invasive plant species, as defined by DCR-DNH (Appendix E), in the ponds.
- Provide a complete list of mammal, bird, amphibian, reptile, and odonate (damselfly and dragonfly) species associated with the ponds.
- Classify the vegetation community within the ponds for those with natural conditions.

## Inventory Methodology

### Habitat Definition

After a brief visit to several of the pond sites in March 1999, it became obvious that a definition was needed to evaluate the wetlands encountered. Heavy rainfall may create ephemeral pools of water in upland sites that support no wetland plant species or provide only insignificant wetland habitat for animal species. Other seasonal wetlands may have intermittent inlet or outlet streams, confusing the usually isolated nature of the depression pond habitat. With consultation among the DCR-DNH ecologists, zoologists and botanists, and after several revisions, the following definition was developed:

The Coastal Plain seasonal wetlands referred to as “sinkhole ponds” in the contract for the Colonial National Historical Park Sinkhole Inventory shall be defined in the following manner: Any natural depression wetland, whether geological in origin or of some other natural derivation, generally surrounded by forest, with a seasonally flooded to semipermanently flooded hydrologic regime isolated from a perennially flowing stream and supporting vegetation consisting of at least one obligate wetland indicator or a prevalence of facultative wetland indicators. A natural depression wetland that meets the above definition but which has an intermittently flowing inlet or outlet stream will also be considered a “sinkhole pond”. The wetland indicator status of a taxon will be that defined by the National Wetlands Inventory of the US Fish and Wildlife Service (Reed 1986). [Some of the wetland plant species likely to be encountered in the seasonal wetlands of Colonial National Historical Park are shown in Appendix A.] Further support for the isolated nature of these wetlands will be the presence of faunal components typically found in isolated wetlands, including but not limited to salamanders of the genus *Ambystoma* (*A. tigrinum*, *A. mabeei*, *A. opacum*), fairy shrimp (Anostraca), clam shrimp (Conchostraca), barking tree frog

(*Hyla gratiosa*), and the comet darner (*Anax longipes*). Community classification will be done primarily in the undisturbed wetlands supporting predominately native vegetation, but depression wetlands that have had some modification of the natural light regime due to alteration of the canopy within or adjacent to the wetland shall be classified if native species predominate. Natural depression wetlands in open, heavily disturbed habitat supporting predominately exotic species will not be considered natural communities, but will be fully documented by the botanists and zoologists according to the objectives stated in the Contract.

In 1999 all 35 potential pond sites (Figure 2) were visited to initially determine if a seasonal wetland meeting the definition stated above was present. After it was determined if a site contained a seasonal wetland that would be included in this study, the ecological, zoological and botanical objectives stated earlier in the Methodology section were carried out at each of the ponds. The specific materials and methodology employed by the major disciplines in carrying out the above objectives are summarized as follows:

### **Community Inventory**

The need to protect indigenous biotic communities and ecosystems has become a major focus of conservation efforts by Federal, State, and private organizations in recent years. The current belief is that by conserving rare and high quality examples of ecological communities, the majority of biodiversity will be protected (Anderson et al. 1999). Community classification, inventory, and protection should be regarded as an essential component of rare species inventories. Natural communities represent functioning units of the landscape which: support a myriad of life forms too cryptic or poorly known to be catalogued and prioritized individually; provide critical habitat for both common and rare species; and contribute to the maintenance of larger ecosystems.

Most community types have not yet been fully defined or ranked due to ongoing classification efforts by the Federal Geographic Data Committee, The Nature Conservancy, and the network of natural heritage ecologists (Anderson et al. 1998). In Virginia, the current definition of communities is at a broad, natural community group level (Fleming et al. 2001). Classification at the natural community level groups together community types with similar structural, floristic, and habitat similarities, e.g., dry oak-hickory forests. Thus, a natural community group is essentially a group of ecologically allied community types.

The sinkhole ponds at CNHP are classified as Coastal Plain Depression Ponds. The best-documented examples of this group in Virginia are the Grafton Ponds, located on The Peninsula in York County, but other sizeable complexes occur on Coastal Plain terraces in Dinwiddie, Surry, Isle of Wight, Gloucester, and Matthews Counties. The CNHP ponds are part of the Grafton Ponds Complex. Because Coastal Plain Depression Ponds occur on limited substrates and are known to support rare species, these communities are considered element occurrences in Virginia if they are in good natural condition.

Data collection began in early 2000 with a review of BCD database information, scientific literature, and resources gathered from the Newport News (Grafton) Ponds. The methods and classification developed by DCR-DNH for the Grafton Pond Sinkhole Complex were also reviewed. The sinkhole database of CNHP, developed by VIMS, provided the baseline map data for the initial fieldwork.

Ecological fieldwork was conducted from May 2000 through August 2000. During this period, visits were made to ground-truth and update the Park's GIS sinkhole database. The ecologist determined which sinkholes contained natural vegetation. For sinkholes that contain natural communities, vegetation was classified using the Grafton Ponds Complex types developed by DCR-DNH and were later cross-referenced to the national TNC alliance-level community classification. Depression wetlands in the open habitat routinely subjected to repeated disturbance by mowing in Field 10 were not considered natural

communities. Close communication was maintained with botanists and zoologists working on the project, and concurrent multidisciplinary investigation of significant sites was arranged when possible.

Standard information was collected at each sinkhole visited by the ecologist and was coordinated with data collected by botanists and zoologists. Vegetation species lists were recorded at each site, including information on dominant species and community structure. These data allowed for the ecological classification of the CNHP sinkhole vegetation and were shared with the botanist for the compilation of the species lists for each sinkhole pond. If initial assessments showed the vegetation to be of a type not documented by DCR-DNH at Grafton Ponds, releve plot data were taken at the pond. Plot locations were selected to capture representative homogenous vegetation and environmental conditions in the pond. Multiple plots were sampled if needed to capture a range of characteristic microhabitats. For vegetation with less than 5% woody species cover above the shrub layer, a 100 square meter area was sampled. For vegetation with greater than 5% woody species cover above the shrub layer, a 400 square meter plot was sampled. New community plot data, if any, were analyzed using Wards cluster method and non-metric multidimensional scaling ordinations implemented in the software program PC-ORD.

Environmental characteristics were measured at each plot including position within the sinkhole, slope shape and steepness, orientation, surface substrate, and hydrologic regime. Additional data were collected on occurrence condition, biotic and abiotic factors, evidence of disturbance, and immediate or long-term threats. Water depth measurements were obtained using a meter stick and averaging several sample points for each natural pond. DCR-DNH field ecologist Kathleen M. McCoy and field botanist Nancy E. Van Alstine were responsible for the community work at Colonial NHP, with assistance from Kristen Gounaris (CNHP) and Sandra Erdle (DCR-DNH Conservation Planner).

The Coastal Plain Depression Ponds were ranked primarily by their quality and size.

#### Soil Data

Soil samples were collected from each of the ponds included in this study in the following manner. Litter or humus was removed from the surface. A gallon-sized plastic bag was then filled approximately 1/3 full with soil collected and mixed from 4-5 sample sites within the pond. Large, poorly decomposed plant material or rocks were removed. In the DCR-DNH soil laboratory, soils were initially air-dried, then dried more completely in an oven at 50-60°C for 24 hours. The dried soil was then sieved and a subset of this sample was sent to Brookside Laboratories, Inc. in Knoxville, Ohio. Soils were analyzed for pH, phosphorus (P), exchangeable cations (calcium [Ca], magnesium [Mg], potassium [K], and sodium [Na], in ppm), and extractable micronutrients (boron [B], iron [Fe], manganese [Mn], copper [Cu], zinc [Zn], and aluminum [Al], in ppm). Mehlich III extraction procedures were used for analysis (M. Flock, pers. comm.). Soil color, both dry and moist, was determined using the Munsell Soil Color Charts.

#### **Zoological Inventory**

For purposes of this study, rare animals are defined as the rarest known species in Virginia. They include species with global ranks of G1, G2, and G3, and state ranks of S1, S2, S3, SH, SX, and SU. Data on species with state ranks of S1, S2 (or S2S3), SH, and SX are maintained in the BCD system and summarized regularly on a master list of Virginia's rare animals (Roble 1996). Species with state ranks of S3 and SU are not tracked using BCD, but maintained on a separate "watchlist." Only general information about watchlist species is recorded in the field and maintained in manual information files.

To initiate inventory of rare animals at CNHP, existing data on element occurrences within and near the park were obtained from the BCD database and reviewed. Additional information was gathered from zoological literature and from examination of selected collections at the following institutions: U.S. Museum of Natural History, the Carnegie Museum, Lord Fairfax Community College, Eastern Mennonite

College, Old Dominion University, Virginia Polytechnic Institute and State University, Virginia Commonwealth University, and the Virginia Museum of Natural History.

Prior to this survey, several rare animals were identified as target species, those with a high probability of being found on the habitats at CNHP. In sinkhole ponds on the Grafton Pond Natural Area Preserve, which is adjacent to CNHP, two rare amphibians, Mabee's salamander (*Ambystoma mabeei*) (G5/S1S2) and barking treefrog (*Hyla gratiosa*) (G5/S1) and two rare odonates, duckweed firetail (*Telebasis byersi*) (G5/S1) and comet darner (*Anax longipes*) (G5/S2), have been found during DCR-DNH surveys. With this target list developed, appropriate survey techniques were planned (see below for methods employed).

Zoological surveys of the sinkhole ponds took place April – May 1999 and February – August 2000. The inventory focused upon rare, threatened, and endangered animal species including amphibians, semi-aquatic reptiles, water birds, and aquatic to semi-aquatic insects (especially odonates). Inventory for targeted species required repeated visits to the sinkholes at different seasons.

A full complement of inventory and sampling methods was employed, including:

Sweep nets – Odonates and other flying invertebrates were sampled near aquatic habitats using sweep nets.

Dip nets – Aquatic vertebrates and invertebrates were sampled with dip nets in all ponds on multiple occasions throughout the survey period.

Hand collection – Logs, bark, leaf litter, and other cover items near the sinkhole ponds were examined for the presence of amphibians and reptiles.

Minnow traps and bottle traps – Aquatic vertebrates and invertebrates were sampled with submerged or partially submerged minnow traps and bottle traps left overnight in selected ponds.

UV-light traps – Nocturnal invertebrates were captured using standard bucket traps equipped with a blacklight (= ultraviolet) powered by a 12-volt gel-cell battery. Ethyl acetate was used as a killing agent. Two traps were run overnight at two ponds.

Dipnetting, sweepnetting, visual and aural surveys were conducted during each visit if water was present in the pond basins. Table 3 shows locations of traps set during the course of the year. The use of bottle traps and minnow traps was limited by the water level.

**Table 3. Number of traps set at two sinkhole ponds at Colonial National Historical Park, 2000.**

	Pond 46	Pond 15
Bottle Trap (22 May)	4	4
Minnow Trap (22 May)	8	14
UV light Trap (29 Aug)	1	1

All vertebrate identifications are given at the species level. Most insects (with the exception of Ephemeroptera and Diptera) were identified to at least family level (species level for adult Odonata). Selected non-insect invertebrate groups were noted only to order. Only species considered aquatic, semi-

aquatic and water birds are reported here. All specimens collected during the study were preserved using standard methods (Martin 1977, McDiarmid 1994). Most of the specimens have been or will be deposited in the Virginia Museum of Natural History; some specimens may be deposited in the National Museum of Natural History and the reference collection (primarily Lepidoptera and Odonata) of DCR-DNH.

### **Botanical Inventory**

All botanical surveys in the ponds were conducted between April 13, 1999, and October 5, 2000. Each pond to be included in the in-depth survey was visited from 3 - 6 times. Field botanist Nancy Van Alstine conducted the majority of the surveys, with field botanist Allen Belden conducting the surveys at the potential pond sites # 29, 30, 31, 32, 34, 35, 36, 37, and 38. Field ecologist Kathleen McCoy also collected botanical data in the course of the community inventory work. CNHP Natural Resource Technician Kristen Gounaris assisted on several of the survey dates.

#### Plant Lists

A complete list of all vascular plant species present was recorded for each pond. Identifications were made either in the field or after examination of collected specimens. Only significant plant specimens will be deposited at the herbarium of the College of William and Mary. The lists include those species recorded by both the field botanist and the field ecologist. Nomenclature follows Kartesz (1999). Although this inventory focused on the vascular plant species present, *Sphagnum* moss specimens were collected at a few sites (15, 55a and 55c) and sent off for determination by Dr. Jonathan Shaw of Duke University.

#### Rare Plant Inventory

For purposes of this study, rare plants are defined as the rarest known species in Virginia as designated by DCR-DNH. In Virginia, rare plants include species with global ranks of G1, G2, and G3, and state ranks of S1, S2, SH, and SX. Data on species with state ranks of S1, S2 (or S2S3), SH, and SX are maintained in the BCD system and summarized annually on a master list of Virginia's rare plants (Killeffer 2000, Department of Conservation and Recreation 2001). Species with state ranks of S3 and SU are not tracked using BCD, but maintained on a separate "watchlist." Only general information about watchlist species is recorded in the field and maintained in manual information files.

To initiate the inventory of rare plants within the coastal plain depression ponds at CNHP, existing data on element occurrences in this habitat type near CNHP were obtained from the report on the study conducted at the Grafton Ponds site from April 1995 – June 1997 (Rawinski 1997). The plant rarities found at Grafton Ponds are shown in Table 4.

**Table 4. Rare plants potentially to be found in the coastal plain depression ponds of Colonial National Historical Park.**

SCIENTIFIC NAME	COMMON NAME	GLOBAL RARITY RANK	STATE RARITY RANK	USFWS STATUS	VA LEGAL STATUS
<i>Calamovilfa brevipiles</i>	pine-barren reed grass	G4	S1		
<i>Chelone cuthbertii</i>	Cuthbert turtlehead	G3?	S2		
<i>Fimbristylis perpusilla</i>	Harper's fimbriistylis	G2	S1		LE
<i>Hottonia inflata</i>	featherfoil	G4	S2		
<i>Hypericum setosum</i>	A St. John's-wort	G4G5	S1S2		
<i>Litsea aestivalis</i>	pondspice	G3	S1		
<i>Sabatia campanulata</i>	slender marsh-pink	G5	S2		
<i>Sphagnum macrophyllum</i> var. <i>macrophyllum</i>	large-leaf peatmoss	G3T3	S2		

In addition, DCR-DNH's BCD database and manual files were reviewed. This information is, in part, gathered from botanical literature and from examination of collections at the following institutions: College of William and Mary, George Mason University, Longwood College, Lynchburg College, National Arboretum, Old Dominion University, University of Richmond, U.S. National Herbarium (Smithsonian Institution), University of North Carolina, Virginia Commonwealth University, and Virginia Polytechnic Institute and State University.

#### Invasive Plant Species

Any invasive plant species, as defined by the DCR-DNH list (Virginia Department of Conservation and Recreation 1999) (Appendix E) was recorded. When invasive species were found, CNHP Biological Technician Kristen Gounaris, who was conducting an invasive species inventory in the Park, was informed so that a determination could be made about mapping the invasive species.

#### Digital Photographs

Multiple photographs were taken at each pond by the field botanist using a Nikon Coolpix 950 digital camera. Photographs were taken from different vantage points within the ponds and at different times of year to obtain views of the site when it was both wet and dry. Photographs were to be taken also of any rare or watchlist plant species encountered. Representative photographs of the seasonal wetlands, usually in both a wet and dry condition, and photographs of the rare and watchlist species observed are included in this report. The full set of digital photographs has been provided to CNHP on a CD.



## RESULTS AND DISCUSSION

Of the 35 potential ponds delineated on the map generated by VIMS (Figure 2), only 9 were determined to fit the definition of a “sinkhole pond” habitat developed for this study; two of these, 47 and 48, located in Field 10 were combined for reporting purposes due to their small size and close proximity. Two seasonal wetlands in Field 10, Pond 42 and 43, could not be assessed based on their vegetation, due to the repeated mowing. Table 5 summarizes the status of each site evaluated, the rare species or significant natural community found, and the site visit chronology.

**Table 5. Results of the field visits to the sites delineated as potential sinkhole ponds at Colonial National Historical Park.** B = visit by botanist, Z = visit by zoologist, E = visit by vegetation ecologist

“POND” #	FINDINGS	RARITIES	SITE VISITS
3	Unreachable head of a deep ravine beyond the tall fence line along the slope leading to the York River. Unlikely site for an isolated wetland.	N/A	6/17/99 – B
10	No evidence of a seasonal wetland other than the roadside ditch.	N/A	4/9/99 – Z 8/17/99 – B
11	No evidence of a seasonal wetland other than the roadside ditch.	N/A	4/9/99 – Z 8/17/99 – B
12	No evidence of isolated seasonal wetland.	N/A	8/17/99 – B
13	A pit and disturbed soil present in approximate area.	No	4/13/99 – B, E, Z
15	A seasonal wetland meeting the pond definition supporting several obligate and facultative wetland species.	No rarities. Contains significant vegetation communities. A watchlisted species, the damselfly <i>Enallagma daeckii</i> present.	4/9/99 – Z 4/13/99 – Z, B, E 8/18/99 – B 3/31/00=Z 5/9/00-E 5/22-23/00-Z 6/14/00-Z 6/29/00-B 7/11/00-E 8/11/00-E 8/29-30/00-Z
16	No evidence of seasonal wetland.	N/A	8/17/99 – B
17	No evidence of seasonal wetland	N/A	8/17/99 – B
18	No evidence of seasonal wetland	N/A	8/17/99 – B
21	No evidence of seasonal wetland	N/A	8/17/99 – B

22	No evidence of seasonal wetland.	N/A	4/13/99 - B, E
24	No evidence of seasonal wetland.	N/A	4/13/99 - B, E
29	Shallow draw at head of steeper drainage ravine. No standing water.	N/A	4/22/99 - B
30	Shallow draw at head of steeper drainage ravine. No standing water.	N/A	4/22/99 - B
31	Slow-draining flatwoods, pine beetle infestation. No standing water.	N/A	4/22/99 - B
32	Slow-draining flatwoods, pine beetle infestation. No standing water.	N/A	4/22/99 - B
34	Visited in April 1999 and described as a shallow draw, with pine beetle infestation, and no standing water, but with a recommendation to be revisited later in the season. Briefly revisited in October 1999 after heavy rains but no obligate or facultative wetland species were present.	No	4/22/99 – B 10/20/99 - B
35	Slow-draining flatwoods, pine beetle infestation. No standing water.	N/A	4/22/99 – B
36	Slow-draining flatwoods, pine beetle infestation. No standing water.	N/A	4/22/99 – B
37	Slow-draining flatwoods, pine beetle infestation. No standing water.	N/A	4/22/99 – B
38	No evidence of a wetland was found but a chip pile was present.	N/A	4/22/99 – B
40	No evidence of a wetland was found but a stand of the invasive silvergrass ( <i>Miscanthus sinensis</i> ) was present.	N/A	4/13/99 - B, Z, E
41	No evidence of a wetland was found, but a dense brush pile was present.	N/A	4/13/99 - E, B, Z
42	Seasonal wetland in open mowed field perhaps partially created or at least enhanced by a berm. Did not flag in 1999 but flagged in 2000 so it would not be mowed. Unfortunately it was mowed twice during the summer, preventing	?	3/10/99 – B, Z, E 2/19/00-Z 3/31/00-Z 4/19/00-B 8/29/00-Z

	evaluation of the vegetation.		
43	Seasonal wetland in open mowed field. Did not flag in 1999 but flagged in 2000 so it would not be mowed. Unfortunately it was mowed twice during the summer, preventing evaluation of the vegetation.	?	3/10/99 – B, Z, E 2/19/00-Z 3/31/00-Z 4/19/00-B 8/29/00-Z 10/5/00-B
44	Seasonal herbaceous wetland in open field. Flagged area on 3/99 so it would not be mowed. Although disturbed, it meets the pond definition based on presence of obligate and facultative wetland species.	No rarities. Two watchlist plant species, <i>Axonopus furcatus</i> and what is probably <i>Eleocharis tenuis</i> var. <i>verrucosa</i> (sterile observed)	3/10/99 – B, Z, E 8/17/99 – B 10/20/99 - B 2/19/00-Z 3/31/00-Z 4/19/00-B 5/12/00-Z 6/14/00 -Z 6/29/00-B 8/29/00-Z 10/5/00-B
45	Seasonal wetland in open field. Did not flag in 1999. Filled with water after heavy rains of fall 1999. Flagged so it would not be mowed in 2000; was mowed in May 2000. Evaluated in late 2000 and determined to meet definition.	No rarities. Two watchlist plant species, <i>Axonopus furcatus</i> and what is probably <i>Eleocharis tenuis</i> var. <i>verrucosa</i> (sterile observed)	3/10/99 – B, Z, E 2/19/00- Z 3/31/00-Z 4/19/00-B 8/29/00-Z 10/5/00-B
46	A linear, but wide seasonal wetland with intermittently-flowing outlet and supporting several obligate and facultative wetland plant species. After review of the data collected, it was determined that this wetland should be more accurately described as a Non-Riverine Wet Hardwood Forest rather than a Coastal Plain Depression Pond. It was evaluated to be a significant natural community.	No	3/10/99 - B, Z, E 5/11/99 - Z 8/17/99 - B 10/20/99 - B 2/19/00-Z 5/9/00-E 5/12/00-Z 5/22-23/00-Z 6/14/00-Z 8/7/00-E 8/29-30/00-Z 10/5/00-B
47-48	(2 small adjacent seasonal wetlands were merged for this report). In open field usually mowed. Flagged in March 1999 so it would not be mowed. Although alien invasive plant species were associated with this area early in the season, late season flora consisted of overwhelmingly native species including mostly obligate or facultative wetland species.	No rarities, but two watchlist plant species, <i>Eleocharis tenuis</i> var. <i>verrucosa</i> and <i>Axonopus furcatus</i> , were found.	3/10/99 - B, Z, E 6/17/99 – B 10/20/99 – B 2/19/00-Z 3/31/00-Z 4/19/00-B 5/12/00-Z 5/22/00-Z 6/14/00-Z 6/29/00-B

47-48 continued			8/29/00-Z 10/5/000B
49	No evidence of a seasonal wetland seen.	N/A	6/17/99 – B
50	Not an isolated seasonal wetland, but a seasonally flooded forested floodplain.	N/A	8/18/99 – B
55	A seasonally wet depression pond – or when seen in 1999, a cluster of 3 wetlands. The one designated as 55c, when GPSed in 2001, was determined to be outside the outlines of the wetland originally mapped as 55.	Yes. Mabee's salamander ( <i>Ambystoma mabeii</i> , a state listed (threatened) amphibian. Spotted turtle (watchlisted species found in ditches associated with this pond complex) Significant vegetation communities.	4/13/99 - Z, B, E 5/11/99 – Z 8/18/99 – B 2/19/00-Z 3/31/00-Z 5/9/00-E 5/12/00-Z 5/18/00-B 6/14/00 –Z 8/11/00-E 8/29/00-Z
62	Seasonal wetland that meets the definition with several obligate and facultative wetland species present.	No rarities. Contains significant vegetation communities.	3/26/99 – Z 6/17/99 – B 8/17/99 – B 4/6/00-Z 4/19/00-B 5/9/00-E 5/18/00-B 5/22/00-Z 6/14/00-Z 8/11/00-E 8/29/00-Z
63	Seasonal wetland that meets the definition with several obligate and facultative wetland species present.	No rarities. Contains a significant vegetation community.	3/26/99 – Z 6/17/99 – B 8/17/99 – B 4/6/00-Z 4/19/00-B 5/9/00-E 5/18/00-B 5/22/00-Z 6/14/00-Z 8/11/00-E 8/29/00-Z

## Community Inventory

### Community classification

Of the nine seasonal ponds recognized at Colonial National Historical Park, five contain natural communities where native plant species assemblages predominate (Ponds 15, 46, 55, 62, and 63). The seasonal ponds that have undergone complete canopy removal, are repeatedly modified by mowing, and are characterized by a larger component of exotic species were not considered natural communities, but were fully documented by the botanists and zoologists (Ponds 44, 45, 47-48). For the ponds that contain natural communities, the vegetation was classified according to the Grafton Pond Complex vegetation types developed by DCR-DNH (Rawinski 1997). The most appropriate cross-reference to the TNC National Vegetation Classification (NVC) alliance is also included. The vegetation composition and structure at Pond 46 differs slightly from the other ponds at CNHP and at Grafton Ponds, so a 400 square meter plot was sampled to determine if the variance was significant (Appendix J). This was the only new community plot data recorded through this survey.

Five associations, with several subtypes and variants, were described for the Grafton Ponds Complex by Rawinski (1997). Two of these associations are present within the natural ponds at Colonial NHP: the Loblolly Pine – Willow Oak / American Holly / Slender Spikegrass (*Pinus taeda* – *Quercus phellos* / *Ilex opaca* var. *opaca* / *Chasmanthium laxum*) association and the Sweetgum – Swamp Black Gum / Cypress-Swamp Sedge (*Liquidambar styraciflua* – *Nyssa biflora* / *Carex jorii*) association. Due to the nature of the ponds, vegetation communities can occur in zones, which are apparently related to water depth and the length of the flooding period. Therefore, more than one association can be found at an individual pond.

**The Loblolly Pine – Willow Oak / American Holly / Slender Spikegrass (*Pinus taeda* – *Quercus phellos* / *Ilex opaca* var. *opaca* / *Chasmanthium laxum*) Association** occurs on the drier margins of the wetland vegetation and grades into the surrounding Mixed Oak/Heath Forest. In addition to the nominal species, red maple (*Acer rubrum*), persimmon (*Diospyros virginiana*), pawpaw (*Asimina triloba*), sourwood (*Oxydendrum arboreum*), common greenbrier (*Smilax rotundifolia*), and partridge-berry (*Mitchella repens*) are characteristic of the community type. Species common to the Mixed Oak/Heath Forest, such as white oak (*Quercus alba*) and American beech (*Fagus grandifolia*), may be present on the upland edge of the pond habitat. Surface substrate is predominantly leaf litter when the surface is exposed. This association is present at Ponds 15, 55, and 62.

**NVC:** *Liquidambar styraciflua* – *Acer rubrum* - *Quercus phellos* / *Leucothoe racemosa* Forest  
[CEGL006110]

**The Sweetgum – (Swamp Black Gum, Black Gum) / Cypress-Swamp Sedge (*Liquidambar styraciflua* – *Nyssa (biflora, sylvatica)* / *Carex jorii*) Association** occurs in the pond habitat with slightly longer periods of inundation and greater water depth than the Loblolly Pine – Willow Oak / American Holly / Slender Spikegrass association. Other characteristic species include overcup oak (*Quercus lyrata*), fetterbush (*Leucothoe racemosa*), royal fern (*Osmunda regalis*), and highbush blueberries (*Vaccinium corymbosum*, *V. formosum*). Surface substrate is predominantly leaf litter when the surface is exposed, with cover potentially contributed by *Sphagnum* spp. It is important to note that the association name determined for the Grafton Ponds Complex did not include *Nyssa sylvatica*. This association name and concept has been broadened to include *Nyssa sylvatica*, which was prevalent at CNHP. This community type is found at four of the natural ponds: Ponds 15, 55, 62, and 63.

**NVC:** *Liquidambar styraciflua* – *Acer rubrum* – *Nyssa biflora* / *Carex jorii* Association  
[CEGL06223]

The vegetation of seasonal wetlands, including Coastal Plain Depression Ponds, can be highly dynamic. Differences in rainfall and the duration of wet and dry periods in the ponds can result in different floristic composition. The Grafton Ponds survey was conducted over a two-year period, which happened to correspond to both a significantly lower and higher yearly precipitation level than average (Rawinski 1997). In that survey, Rawinski noted that information on species richness in this wetland system is not easily obtained, because so many species are evident only during periods of draw-down, while others appear only during prolonged periods of inundation. Species can persist in the seed bank until conditions are suitable for germination. Keddy and Reznicek (1982), in a seed bank study along a lakeshore in Ontario, demonstrated that the highly diverse flora was related to fluctuating water levels. The community survey work at CNHP was conducted over a single season, although supplemented by plant species lists collected over two seasons by the field botanist. The community classification and species lists would likely be more robust with multiple years of data. Hydrologic data could also elucidate the potential relationship of the vegetation communities to inundation periods and water depths.

Initial assessments of Pond 46 suggested that this wetland differs both floristically and physiognomically from the Grafton Pond types. Although this wetland initially met the pond definition developed for this study, several observations have led to its tentative recognition as a Non-Riverine Wet Hardwood Forest. Surface channels indicated that the wetland area may receive surface water input in addition to seasonal flooding. Sinkhole ponds are usually isolated wetlands clearly separated from perennial streams. In addition to the surface channels, the zoologists recorded eastern mud minnows in the wetland. This may indicate at least a historical flooding event which introduced fish into the system from a nearby permanent water source (e.g., Beaverdam Creek to the east). Although active stream inputs were not observed during the study, the delineation of the channels was clear. This elongated wetland is also unusual for a depression pond: depression ponds are typically rounded.

The wetland vegetation at Pond 46 is somewhat more characteristic of Coastal Plain alluvial or non-riverine wetland systems than of coastal plain depression ponds. American hornbeam (*Carpinus caroliniana*) and American elm (*Ulmus americana*), both prevalent at Pond 46, have not been recorded as significant trees from any of Virginia's coastal plain depression ponds. This pond had the highest species diversity (species richness = 55), which may result from species introduction by flowing water. Additionally, the pond's soil calcium values are significantly higher than those of the other natural ponds (Appendix G). The high calcium values may be the result of alluvial inputs. This wetland could not be classified as a Coastal Plain Depression Pond, and is provisionally classified as a Non-Riverine Wet Hardwood Forest. Further study, including hydrologic and geologic research, would be necessary to determine the true nature of this wetland. Due to its mature forest canopy and dominance of native vegetation, this wetland is still worthy of protection. Further description of the Non-Riverine Wet Hardwood Forest Community group follows (from Fleming et al. 2001):

### **Non-Riverine Wet Hardwood Forests**

Saturated to shortly seasonally flooded deciduous forests of poorly drained Coastal Plain terraces. These include broad, outer Coastal Plain interfluvies, as well as the outermost, never-flooded alluvial terraces of major rivers inland. In Virginia, these communities range locally from inland portions of the Eastern Shore south through much of southeastern Virginia. Habitats are flat, with seasonally perched water tables and frequent shallow depressions which pond water intermittently. Soils are silt, sand, and clay loams, sometimes with very thin organic horizons. Mixtures of hydrophytic oaks (*Quercus* spp.) characterize forests of this group. Dominants, varying regionally, include swamp chestnut oak (*Q. michauxii*), cherrybark oak (*Q. pagoda*), willow oak (*Q. phellos*), laurel oak (*Q. laurifolia*), water oak (*Q. nigra*), and pin oak (*Q. palustris*). Cutting and other disturbances result in higher proportions of sweetgum (*Liquidambar styraciflua*), red maple (*Acer rubrum*), and other intolerant trees. Small trees and shrubs include American hornbeam (*Carpinus caroliniana* ssp. *caroliniana*), giant cane (*Arundinaria gigantea* ssp. *tecta*), American holly (*Ilex opaca* var. *opaca*), coastal dog-hobble (*Leucothoe axillaris*),

and highbush blueberries (*Vaccinium* spp.). Herb layers tend to be depauperate, but usually contain netted chain fern (*Woodwardia areolata*) and a variety of sedges, e.g., *Carex abscondita*, *C. debilis* var. *debilis*, *C. intumescens*. Large, rhizomatous colonies of the sedges *Carex striata* var. *brevis*, *C. bullata*, and *C. barrattii* occasionally dominate. Communities of this group have been greatly reduced in extent or modified by extensive agricultural clearing, logging, conversion to pine silvicultures, and hydrologic alterations such as ditching and draining. Most, if not all, community types in this group are now globally uncommon to rare. Associated rare species include the globally rare Virginia least trillium (*Trillium pusillum* var. *virginianum*), the federally listed Dismal Swamp southeastern shrew (*Sorex longirostris fisheri*), and the state-listed canebrake rattlesnake (*Crotalus horridus atricaudatus*). References: Dabel and Day (1977), Day (1985), Fleming and Moorhead (1998), Frost (1995), Train and Day (1982).

#### Soil Characteristics

The results of the soil color determinations and analyses for pH and element levels are shown in Appendices F and G, respectively. All soils collected were evaluated to have a hue of 2.5Y, the presence of a yellow color being an indication of the presence of the oxidized form of iron (Fe III) and an environment of fluctuating water levels. Soil colors were determined to be light to dark grayish brown or brownish gray. All but the moist soil sample from Pond 45 were characterized as having chromas of 2. Low chromas ( $\leq 2$ ) or gray colors are generally indications of saturation and reduction conditions (Vepraskas 1995). In depth discussion of the results of the soil analyses will not be attempted here, but in general the soils of the seasonal wetlands included in this study were acidic (pH of 4.8 or less), high in aluminum, and the ponds within a more natural setting, except for Pond 46 as noted above, were low in calcium. The ponds are also low in boron, potassium, manganese, phosphorus, copper and zinc. Ponds within Field 10 and Pond 46 were less acidic than the other natural ponds and higher in iron. In general, element levels were higher in the Field 10 ponds than in the ponds within the natural setting. Element levels were roughly comparable to those in the Grafton Pond study (Rawinski 1997), except for higher levels of phosphorus, iron, and aluminum in the Colonial NHP ponds. In particular, aluminum levels were higher in the Colonial NHP ponds with mostly over 1000 ppm vs. the Grafton Pond soils with mostly less than 800 ppm (Rawinski 1997). The reason for this difference is not known. Even higher aluminum concentrations have been documented in sinkhole ponds in the Shenandoah Valley of Virginia (Knox 1997). The combination of low pH and high aluminum levels is frequently the most limiting factor in plant growth as it reduces uptake and translocation of plant macronutrients (Foy 1974, Taylor 1988).

### Water depths

Water depths were not systematically recorded during 1999-2000, and water levels are highly variable in these seasonal wetlands, but some measurements were made in the ponds within a natural setting in 2000 to give some indication of water depths at these sites. These are provided in Table 6. In contrast, in 1999, Ponds 15, 55, 62, and 63 were dry on August site visits.

**Table 6. Water depths recorded in the Colonial NHP ponds within a natural setting.**

	May 9, 2000	August 11, 2000*
Pond 15	50 cm	25 cm
Pond 46	20 cm	10 cm
Pond 55**	24 cm	9 cm
Pond 62	34 cm	15 cm
Pond 63	52 cm	15 cm

\* Pond 46 water levels were recorded on August 8, 2000

\*\*Pond 55 values are based on averages from 55a & 55b

### **Zoological Inventory**

In 1999, DCR-DNH zoologists discovered the state listed (threatened) Mabee's salamander, (*Ambystoma mabeei* G4/S1S2), at Pond 55c, one of the three small ponds comprising the pond 55-complex. One adult and numerous larvae were first observed on 13 April 1999. Larvae were also seen during a subsequent visit on 11 May 1999. Surveys in 2000 relocated Mabee's salamander in Pond 55c. On 19 February 2000, several adults (3 males and 1 female), two small larvae, and eggs of the Mabee's salamander were observed. Several larvae and eggs were found on 31 March 2000 and on 12 May 2000 but no adults were observed. Mabee's salamander was not found in other sinkhole ponds on the CNHP property; however it is known from similar ponds on land adjacent to CNHP (DCR-DNH database).

Mabee's salamander is a pond-breeding amphibian, which prefers fish-free ponds such as ephemeral ponds or vernal pools. Adults migrate to the breeding pond during warm, heavy rains in late winter or early spring (typically February – late March) (Petranka 1998). Larvae hatch 9-14 days after the egg has been oviposited (Petranka 1998). The larval period lasts a few months with larvae transforming (i.e., losing gills and growing legs, etc.) in early to mid-May (Petranka 1998). Both adults and juveniles return to the pond only to breed, thus spending most of the year in the adjacent uplands.

No other rare species have been identified to date from the CNHP sinkhole ponds; however, some identifications are still pending. The watchlisted spotted turtle (*Clemmys guttata*) was observed in a ditch in close proximity to the pond 55-complex. Most likely, it utilizes all the wetlands in the area. A second watchlisted species, the damselfly *Enallagma daeckii*, was found at Pond 15. Appendix B contains the lists of observed and collected species for each pond surveyed as well as the total number of different taxonomic groups observed from each pond.

In brief, Ponds 15, 55-complex (though most of the diversity is attributable to 55c), and 46 yielded the highest taxa diversity (See Appendix B for a definition of 'taxa diversity'). While ponds 15 and 55c contained more vegetative structure (including extensive *Sphagnum* moss) than other ponds, pond 46 occasionally connects with a small stream to the east during high flood times and some species may use it as a natural corridor. Likewise, Pond 55c is connected to a small stream during high water table periods and may be considered the headwaters of that stream.

The importance of the coastal plain depression ponds to the faunal community is great. Many species depend on these wetlands for completion of their life cycle. They are also an important water source for



wildlife both as a freshwater drinking source and as links connecting wetlands together as species move about (Kenny and Burne 2000). Loss of these wetlands within CNHP would be detrimental to the overall faunal diversity of the Park.

## **Botanical Inventory**

### Rare species

No rare, threatened, or endangered plant species were found in any of the ponds included within this study. Two species designated as watchlist species by DCR-DNH, big carpet grass (*Axonopus furcatus*) and slender spikerush (*Eleocharis tenuis* var. *verrucosa*) were found, not in the undisturbed wetlands, but in the ponds in Field 10, Ponds 44, 45, and 47-48. Specimens of these taxa will be deposited at the College of William and Mary Herbarium.

### Pond flora

All of the wetlands surveyed supported taxa of varying moisture requirements. Woody species were generally characterized as Facultative Upland (1-33% frequency in wetlands) or Facultative (34-66% frequency in wetlands). Exceptions to this were overcup oak (*Quercus lyrata*) (Obligate-greater than 99% frequency in wetlands) and laurel oak (*Quercus laurifolia*) (Facultative Wetland –67-99% frequency in wetlands-) found in Pond 62 and the Facultative Wetland shrubs fetterbush (*Leucothoe racemosa*) and highbush blueberry (*Vaccinium corymbosum*) [and probably the unranked swamp highbush blueberry (*Vaccinium formosum*)] found in a number of the ponds. More herbaceous species were characterized as Obligate or Facultative Wetland, but Facultative and Facultative Upland were present also, occupying the outer edges or hummocks within the wetland.

In general, the undisturbed ponds supported a depauperate flora, particularly of herbaceous species; Ponds 15, 55c, 62, and 63 supported a total of 22 or fewer vascular taxa. This is comparable to or in many cases even higher than the totals at the Grafton Ponds surveyed by Rawinski (1997). The combined 55a and 55b wetland supported the greatest diversity (35 taxa) of the undisturbed wetlands classified as Coastal Plain Depression Ponds, its higher diversity arising from a greater number of herbaceous taxa, although herbaceous cover was low in all the undisturbed ponds. Several of the ponds (Ponds 15 and 55c) contained a dense *Sphagnum* moss layer while others had a thick leaf litter layer (Ponds 55a and b, 62 and 63). Rawinski (1997) found that a thick layer of poorly decomposed leaf litter in one of the Grafton Ponds inhibited the establishment of herbaceous species and the *Sphagnum* layer appears to have a similar effect.

The undisturbed ponds within CNHP supported many species commonly found in the Grafton Ponds surveyed by Rawinski outside of CNHP. Among the woody species this included sweet gum, red maple, black gum, loblolly pine, willow oak, pawpaw, highbush blueberry, and fetterbush. Cypress-swamp sedge (*Carex jorii*) the most frequently present herbaceous species in the Grafton Pond complex outside of Colonial NHP, was present in all of the undisturbed ponds at CNHP. None of the *Nyssa* sp. observed in the Colonial NHP ponds appeared to be swamp black gum (*Nyssa biflora*), a species seen, along with black gum (*Nyssa sylvatica*), in many of the Grafton Ponds. None of the plant rarities encountered by Rawinski (1997) were found in the CNHP ponds.

The seasonal wetlands heavily disturbed by complete canopy removal and frequent mowing in Field 10, Ponds 44, 45, and 47-48, supported a different and, in at least Ponds 44 and 47-48, a more diverse flora (45 and 51 taxa, respectively) than the undisturbed wetlands, attributed to higher numbers of herbaceous taxa. Species such as the tall flat panic grasses (*Panicum rigidulum* var. *rigidulum*, *P. var. elongatum*), smartweeds (*Polygonum* spp.), and rushes (*Juncus* spp.) were prominent. The watchlist species big carpet grass and slender spikerush, noted above, were found within these disturbed wetlands. Herbaceous cover, although not quantified, was dense in the Field ponds compared to the undisturbed ponds. Pond 45 was less diverse, but this may reflect a shorter period of time without mowing than Ponds 44 and 47-48.

Although non-native species were present in these disturbed wetlands, and even prevalent early in the season, the summer and fall flora was composed predominantly of native species. Higher diversity and denser coverage is likely linked to higher nutrient levels (Appendix G) and increased sunlight in the open habitats.

The most diverse flora was found in the “Pond” 46 site, with more than twice as many taxa (55) as the other ponds within a natural setting. This difference in diversity arises from the greater number of herbaceous species at “Pond” 46. The higher diversity and the nature of the species present at “Pond” 46 are partial reasons for the designation of this wetland as a Non-Riverine Wet Hardwood Forest rather than a Coastal Plain Depression Pond (See Results and Discussion in Community Inventory). The levels of some nutrients (calcium, phosphorus, potassium, copper, magnesium, and manganese) at “Pond” 46, more similar to the Field 10 ponds than to the undisturbed ponds, indicate a more fertile habitat. Although more diverse, the sparse herbaceous cover in “Pond” 46 is more similar to the undisturbed ponds, probably attributed to the inhibiting effect of the thick leaf litter layer.

#### Invasive Plant Species

The undisturbed ponds, 15, 46, 55, 62, and 63, were largely free of invasive alien plant species. The exceptions were small patches of Japanese stilt grass (*Microstegium vimineum*) and Japanese honeysuckle (*Lonicera japonica*) on drier sites within or on the edge of Pond 46. The ponds in Field 10, 44, 45, and 47-48, supported a number of invasive aliens including velvet-grass (*Holcus lanatus*), meadow fescue (*Lolium pratense*), Bermuda grass (*Cynodon dactylon*), and sheep sorrel (*Rumex acetosella*). Other alien plant species not included on the invasive list (Virginia Department of Conservation and Recreation 1999) were present, such as sweet vernal grass (*Anthoxanthum odoratum*). Non-native species were prominent early in the season in the Field 10 wetlands. After consultation with the Natural Resource Technician and the CNHP Resource Manager, it was decided not to map the invasive alien species found during this survey.

## Introduction to the Site Reports

To enhance protection and facilitate management of biodiversity at Colonial National Historical Park, boundaries have been provided for landscape units which merit practical and justifiable recommendation as conservation sites. For purposes of this report, a Conservation Site is a natural area that includes one or more element occurrences and has been assigned a biodiversity rank of at least B5. Three of these Conservation Sites containing rare species, coastal plain depression ponds or other significant wetland communities were identified based on the results of this inventory. Reports follow for these Conservation Sites. The following standard reporting format is used for each Conservation Site:

**SITE NAME:** Site names generally reflect a geographic locality and, in some cases, a prevalent landscape feature.

**SIZE:** The acreage within the conservation planning boundary, as determined using the calcacre.ave script in ArcView 3.2, is given.

**BIODIVERSITY RANK:** The overall significance of the natural area, in terms of the rarity of natural heritage resources and the quality of their occurrences, is indicated. As described in the Methodology section, these ranks range from B1 (very high significance) to B5 (general biodiversity significance).

**LOCALITY:** The county (or counties) containing the site is listed.

**QUADRANGLE:** The name of the USGS 7.5' quadrangle(s) that includes the site is listed.

**QUADRANGLE CODE:** The code used by DCR-DNH for the quadrangle is listed. The first five digits of the code represent latitude and longitude (in degrees) of the quadrangle.

**LOCATION:** Location of the site within Colonial National Historical Park, using geographical landmarks, is given.

**NATURAL HERITAGE RESOURCE SUMMARY TABLE:** This field provides a synopsis of the natural heritage resources (rare species and significant communities), together with their status ranks (global, state, USFWS (federal), Virginia legal and element occurrence ranks).

**SITE DESCRIPTION:** A brief narrative describing the site, its significant elements, vegetation, habitat, and current land use is presented. The first reference to a species in a narrative is by common name, followed by its scientific name in parentheses. Subsequent references to the same species are by common name only.

**BOUNDARY JUSTIFICATION:** The preliminary Conservation Planning Boundary delineated in this report contains all known occurrences of natural heritage resources and adjacent buffer lands required for their immediate protection. The information field explains the basis for the specific site boundaries.

**THREATS:** Threats to the site and its natural heritage resources are described. These may include both real, imminent threats and potential threats posed by types of land use activities or other factors that currently are not impacting the site.

**MANAGEMENT RECOMMENDATIONS:** This field is a summary of the major issues and factors that should be considered in management of the site for its biodiversity and natural heritage resource values. As a rule, generalized recommendations are provided based on potential threats identified during the survey work. The expertise of inventory biologists familiar with each site, as well as input from

DCR-DNH natural areas program biologists, has been utilized in preparing these recommendations. However, within the context of a short-term (2 year) inventory effort it may be difficult to identify highly specific management strategies. In many cases, monitoring of element occurrences or site factors is recommended to determine the best long-term management practices. In all cases, if land use changes or specific high-impact actions are proposed within a site's boundary, consultation with DCR-DNH staff is recommended to assess impacts on the natural heritage resources.

**PROTECTION RECOMMENDATIONS:** A summary of the actions and priority needed to ensure long-term protection of the site and its elements is provided.

**REFERENCES:** Pertinent literature is listed.

**SITE MAPS:** The site map, drawn on copies of the USGS 7.5' quad(s), shows the preliminary Conservation Planning Boundary. This boundary includes additional land determined to be important for long-term maintenance of the elements and considers the following factors when drawing these boundaries.

- the extent of current and potential habitat for rare species and exemplary natural communities;
- species movement and migration corridors;
- maintenance of surface water quality within the site and the surrounding watershed;
- maintenance of the hydrologic integrity of groundwater resources;
- land intended to mitigate a wide variety of off-site impacts;
- land or activities necessary to preclude or minimize exotic species; and
- land necessary for management activities, e.g., prescribed burning.

The boundaries are intended for conservation planning purposes and, at the very least, should prevent inadvertent damage to the natural areas.

**ELEMENT LOCATION MAPS:** Maps showing the exact location of each element occurrence within a site are included following the site map. In the case of animal elements, which are often highly mobile organisms, the maps indicate where actual collections were made and/or specimens were observed. These location maps are intended to provide Colonial National Historical Park natural resource managers with requisite site-specific information. However, since rare species are often sensitive to disturbance or may be sought out by collectors, we strongly recommend that this information not be shared with the general public or with persons not directly involved in the stewardship of these sites.

**CRAWFORD ROAD POND**  
(Pond 15)

**Size:** Ca. 46 acres

**Biodiversity Rank:** B2

**Locality:** York County, VA

**Quadrangle:** Yorktown

**Quadrangle Code:** 3707625

**Location:** Just west of Crawford Road, ca. 0.8 kilometers north of the Crawford Road crossing of Baptist Run, Colonial National Historical Park.

**NATURAL HERITAGE RESOURCES SUMMARY TABLE**

ELEMENT NAME	GLOBAL RARITY RANKS	STATE RARITY RANKS	USFWS STATUS	VA LEGAL STATUS	ELEMENT OCCURRENCE RANK
COMMUNITIES:					
Coastal Plain Depression Pond Loblolly Pine-Willow Oak Type	G?	S1	-	-	B
Coastal Plain Depression Pond Sweetgum – Swamp Black Gum (-Black Gum) Type	G1G2?	S1	-	--	B

ANIMALS: None

PLANTS: None

**Site Description:** This site contains a Coastal Plain Depression Pond (Pond 15) within a forest matrix. Sweetgum (*Liquidambar styraciflua*) contributes the most woody stems in this seasonal pond, but willow oak (*Quercus phellos*) and red maple (*Acer rubrum*) also contribute high cover. A hummock in the middle of this pond supports a dense stand of fetterbush (*Leucothoe racemosa*). The *Sphagnum* layer is highly developed. Both the Loblolly Pine – Willow Oak / American Holly / Slender Spikegrass (*Pinus taeda* – *Quercus phellos* / *Ilex opaca* var. *opaca* / *Chasmanthium laxum*) Association and the Sweetgum – Swamp Black Gum (-Black Gum) / Cypress-swamp Sedge (*Liquidambar styraciflua* – *Nyssa biflora* – *Nyssa sylvatica* / *Carex joorii*) Association defined for the Grafton Ponds Complex (Rawinski 1997) are found at this site. The watchlist damselfly *Enallagma daeckii* was observed.

**Boundary Justification:** The boundary contains the significant natural community and adjacent uplands within at least the surface flow watershed for the pond. The recharge zone for any groundwater input into the pond is currently unknown and hydrological studies may result in modification of this boundary. Protection of the watershed for this pond is critical in order to maintain the hydrological regime of the pond and the vegetation communities it supports. An upland buffer may also provide some protection from the introduction of invasive alien plant species.

**Threats:** None noted at the time of survey.

**Management Recommendations:** Development, tree canopy alteration (e.g., logging), and nutrient input would alter the quality of the pond and its associated vegetation. The site should be protected from

ground water contamination and disturbances to the hydrologic regime. Timber harvesting of the surrounding uplands should be restricted. The status of the vegetation communities present should be monitored. Hydrological studies are needed to determine the relative importance of input from groundwater vs. surface flow.

**Protection Recommendations:** Protection measures should include the implementation of management recommendations and consultation with DCR-DNH when changes in land use or management practices are contemplated. The Conservation Planning Boundary should be formally incorporated into the planning and management documents for Colonial National Historical Park.

#### **References:**

Rawinski, T.J. 1997. Vegetation ecology of the Grafton Ponds, York County, Virginia, with notes on Waterfowl use. Natural Heritage Technical Report 97-10. Virginia Department of Conservation and Recreation, Division of Natural Heritage, Richmond. 42 pp. plus appendix.

**GRAFTON PONDS**  
(Ponds 55a, b, and c, 62, and 63)  
(INCLUDES ONLY THE PORTION WITHIN CNHP)

**Size:** Ca. 2480 for total site,  
Ca. 190 acres within CNHP

**Biodiversity Rank:** B2

**Locality:** York County, VA

**Quadrangle:** Yorktown  
(full site extends onto Poquoson West Quad)

**Quadrangle Code:** 3707625  
(+ 3707624)

**Location:** An extensive site, mostly outside of Colonial National Historical Park, extending from the Historical Tour Drive in CNHP, south and southeast for ca. 6.4 kilometers. The section within CNHP lies east of Beaverdam Creek and west of Yorktown School.

**NATURAL HERITAGE RESOURCES SUMMARY TABLE**

ELEMENT NAME	GLOBAL RARITY RANKS	STATE RARITY RANKS	USFWS STATUS	VA LEGAL STATUS	ELEMENT OCCURRENCE RANK
<b>COMMUNITIES:</b>					
Coastal Plain Depression Pond Loblolly Pine-Willow Oak Type (Pond 55 complex)	G?	S1	-	-	B
Coastal Plain Depression Pond Loblolly Pine-Willow Oak Type (Pond 62)	G?	S1	-	-	B
Coastal Plain Depression Pond Sweetgum – Swamp Black Gum (-Black Gum) Type (Pond 55 complex)	G1G2?	S1	-	-	B
Coastal Plain Depression Pond Sweetgum – Swamp Black Gum (-Black Gum) Type (Pond 62)	G1G2?	S1	-	-	BC
Coastal Plain Depression Pond Sweetgum – Swamp Black Gum (-Black Gum) Type (Pond 63)	G1G2?	S1	-	-	B
<b>ANIMALS:</b>					
<i>Ambystoma mabeei</i> (Mabee's salamander)	G4	S1S2	-	LT	C
<b>PLANTS:</b> None					

**Site Description:** This area within CNHP includes the Pond 55 complex and Ponds 62 and 63 but is only the northwest corner of the large Grafton Ponds Conservation Site. Only the rare species and significant communities within Colonial NHP are listed above and will be discussed here. A more extensive list of the rarities found within the larger Grafton Ponds site is provided in Appendix H. The conservation focus of this part of the larger site includes two areas: the northernmost is a series of seasonally wet, shallow depressions, the Pond 55 complex (55a, b, and c), at or near the head of a low gradient stream drainage within a forested matrix within the Beaverdam Creek drainage and the southernmost includes two ponds, 62 and 63, just north of the Grafton Ponds Natural Area Preserve. Both the Loblolly Pine – Willow Oak / American Holly / Slender Spikegrass (*Pinus taeda* – *Quercus phellos* / *Ilex opaca* var. *opaca* / *Chasmanthium laxum*) Association and the Sweetgum – Swamp Black Gum (-Black Gum) / Cypress-swamp Sedge (*Liquidambar styraciflua* – *Nyssa biflora* (*Nyssa sylvatica*) / *Carex joorii*) Association (Rawinski 1997) are found within the Colonial National Historical Park area of this site.

**Pond 55 complex:** The least ephemeral of the three ponds included in this complex, 55c, the eastern-most pond, is a small *Sphagnum* moss-dominated wetland with intermittent outlet to the southeast. This pond supports the state listed threatened Mabee's salamander (*Ambystoma mabeei*) and the complex of wetlands supports significant Coastal Plain Depression Pond communities, the Loblolly Pine – Willow Oak / American Holly / Slender Spikegrass Association and the Sweet Gum-Swamp Black Gum (-Black Gum) / Cypress-swamp Sedge association. The wetlands are located on the edge of an area modified by Revolutionary War earthworks and the two more ephemeral ponds (55a and 55b) may be partially influenced by these earthworks.

**Ponds 62 and 63:** Two Coastal Plain Depression Ponds, Ponds 62 and 63, lie within a forested area just north of the Grafton Ponds Natural Area Preserve, owned by the City of Newport News, and just west of a residential development. A gated road occurs north and west of these two ponds. A trail associated with the Grafton Ponds Natural Area Preserve runs between the two ponds. Canopy trees at the two ponds are similar and include red maple (*Acer rubrum*), sweet gum (*Liquidambar styraciflua*), willow oak (*Quercus phellos*), loblolly pine (*Pinus taeda*), and blackgum (*Nyssa sylvatica*). Pond 62 also includes (*Quercus lyrata*). Pond 62 contains both the Loblolly Pine – Willow Oak / American Holly / Slender Spikegrass Association and the Sweetgum – Swamp Black Gum (-Black Gum) / Cypress-swamp Sedge Association and Pond 63 supports the Sweetgum – Swamp Black Gum (-Black Gum) / Cypress-swamp Sedge Association

**Boundary Justification:** The boundary includes the pond habitat for the Mabee's salamander and the significant communities and adjacent uplands within and beyond at least the surface flow watershed for the ponds. The recharge zone for any groundwater input into the ponds is currently unknown and hydrological studies may result in modification of this boundary. Protection of the watershed of these ponds is critical in order to maintain the hydrological regime, habitat for the Mabee's salamander, and the wetland vegetation communities. The boundary is extended downstream on the tributary of Beaverdam Creek as the salamanders use wet areas as migration corridors. Uplands are used by the Mabee's salamander for shelter and feeding outside of the breeding season. The boundary also extends southeast, off of land managed by CNHP, to encompass the large complex of seasonal wetlands within the larger Grafton Ponds site.

**Threats:** Pond 62 lies just behind a residential development and at the time of these surveys, a small amount of trash had been dumped in this pond.

**Management Recommendations.** The management strategy for Mabee's salamander includes assuring that the breeding pond is protected from altered hydrological regimes and contamination of the groundwater. Actions such as timber harvesting or ditching could have detrimental effects on breeding sites. Likewise, it is important to preserve non-breeding habitat (the surrounding terrestrial uplands)



which is used for shelter and feeding, by preventing urban development and forestry practices that remove vegetative cover and alter the landscape (Pague and Mitchell 1991).

Although little information is available on the terrestrial ecology of Mabee's salamander, it is documented that some adults may move a considerable distance away from the breeding sites (Pague and Mitchell 1991). The possibility exists that the CNHP population is part of a 'metapopulation' with the populations found about 1 km to the southeast. If this is the case, then care must also be taken to not significantly alter the habitat that joins the populations. Further detailed studies are needed on all these populations to determine their life histories, habitat requirements for both breeding and non-breeding sites, and if there is genetic exchange between the population at CNHP and the population inhabiting sinkhole ponds on adjacent lands.

The trash present in Pond 62 should be removed and future dumping of trash should be discouraged. Hydrological studies are needed to clarify the relative importance of groundwater vs. surface flow to the hydrological regimes of the ponds. The status of the Mabee's salamander population and the vegetation communities should be periodically monitored.

**Protection Recommendations:** Protection measures should include the implementation of management recommendations and consultation with DCR-DNH when changes in land use or management practices are contemplated. CNHP should work with the City of Newport News and residential landowners adjacent to Ponds 62 and 63 to protect the quality of the Natural Heritage Resources within the entire site. The Conservation Planning Boundary should be formally incorporated into the planning and management documents for Colonial National Historical Park.

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# TOUR DRIVE SWAMP ("Pond" 46)

**Size:** Ca. 30 acres

**Biodiversity Rank:** B4

**Locality:** York County, VA

**Quadrangle:** Yorktown

**Quadrangle Code:** 3707625

**Location:** Ca. 0.5 kilometers east-northeast of Washington's Headquarters, less than 0.16 kilometers north of the Historical Tour Drive, near the road's direction change from east-west to north-south, 0.32 kilometers south of the French Cemetery, Colonial National Historical Park.

## NATURAL HERITAGE RESOURCES SUMMARY TABLE

ELEMENT NAME	GLOBAL RARITY RANKS	STATE RARITY RANKS	USFWS STATUS	VA LEGAL STATUS	ELEMENT OCCURRENCE RANK
COMMUNITIES: Non-Riverine Wet Hardwood Forest	G?	S1	-	-	B

ANIMALS: None

PLANTS: None

**Site Description:** This site supports a significant wetland community with a mature forest canopy and predominantly native wetland vegetation. The community has been tentatively described as a Non-Riverine Wet Hardwood Forest. The wetland is elongate and has surface inlet and outlet channels at its eastern and western ends. Although surface water flow into the wetland was not observed during the study period, the wetland may receive surface water input in addition to seasonal flooding. The zoologists recorded eastern mud minnows in the wetland, which may indicate at least a historical flooding event which introduced fish into the system from a nearby permanent water source (e.g., Beaverdam Creek to the east). No rare animals or plants were found in the 1999-2000 survey.

The wetland vegetation at "Pond" 46 is most characteristic of Coastal Plain alluvial or non-riverine wetland systems. Willow oak (*Quercus phellos*), loblolly pine (*Pinus taeda*) and sweetgum (*Liquidambar styraciflua*), are characteristic of the higher tree strata. Red maple (*Acer rubrum*) and black gum (*Nyssa sylvatica*) are common in the understory. American hornbeam (*Carpinus caroliniana*) and American elm (*Ulmus americana*) occur in large numbers at the western end of the wetland. Herb diversity is greater than at the Coastal Plain Depression Ponds and includes cypress-swamp sedge (*Carex jorii*), graceful sedge (*Carex gracillima*), hop sedge (*Carex lupulina*), wood reedgrass (*Cinna arundinacea*), Virginia cutgrass (*Leersia virginica*), tall flat panic grass (*Panicum rigidulum* var. *rigidulum*), autumn bluegrass (*Poa autumnalis*), marsh fern (*Thelypteris palustris* var. *pubescens*), and others.

**Boundary Justification:** The boundary contains the significant natural community and adjacent uplands within the watershed for the wetland as well as downstream buffer lands. The relative importance of the contributions of groundwater vs. surface flow to the hydrology of the seasonal wetlands present is currently unknown and future hydrologic work might result in modifications of the boundary. Portions of

the Tour Drive are included as impacts from the road, such as runoff containing contaminants, could affect the quality of the community present.

**Threats:** The invasive alien plant species Japanese honeysuckle (*Lonicera japonica*) and Japanese stilt grass (*Microstegium vimineum*), currently present only in small patches, were the only threats noted at this wetland. The wetland's proximity to the Historical Tour Drive and to Beaverdam Creek makes it more susceptible to invasive species introductions. A potential threat to the quality of the significant community could arise from the proximity of the Historical Tour Drive; contaminants in runoff from the road could negatively affect water quality in the wetland.

**Management Recommendations:** Further study is necessary to determine the hydrologic regime of this wetland and the relative importance of groundwater vs. surface flow. The site should be protected from contamination of the ground water and disturbances to the hydrologic regime. Alterations to the canopy should be restricted. The Japanese honeysuckle and the Japanese stilt grass, which are still only very small occurrences, should be removed. Further study of the community present at this site is needed to assess its rarity and significance.

**Protection Recommendations:** Protection measures should include the implementation of management recommendations and consultation with DCR-DNH when changes in land use or management practices are contemplated. Future potential changes in the Historical Tour Road may impact the wetland, and should be considered in the planning process. The Conservation Planning Boundary should be formally incorporated into the planning and management documents for Colonial National Historical Park.

#### **References:**

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**Sinkholes of Yorktown Battlefield**  
**Biological Report Virginia Division**  
**of Natural Heritage**

**SEASONAL WETLANDS INVENTORIED DURING THE 1999-2000 STUDY**



Pond 15

April 13, 1999

Photographer: Kathleen M. McCoy



Pond 15

August 18, 1999

Photographer: Nancy E. Van Alstine





Pond 44

March 2000

Photographer: Kristen Gounaris



Pond 44

October 5, 2000

Photographer: Nancy E. Van Alstine





“Pond” 46                      April 19, 2000                      Photographer: Nancy E. Van Alstine  
Determined to be a Non-Riverine Wet Hardwood Forest



“Pond” 46                      April 19, 2000                      Photographer: Nancy E. Van Alstine





Pond 55b

April 13, 1999

Photographer: Kathleen M. McCoy



Pond 55b

August 18, 1999

Photographer: Nancy E. Van Alstine





Pond 62

June 17, 1999

Photographer: Nancy E. Van Alstine



Pond 62

April 19, 2000

Photographer: Nancy E. Van Alstine

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**APPENDIX A:**

**WETLAND PLANT SPECIES POTENTIALLY IN THE SEASONAL WETLANDS OF CNHP**

## PLANT TAXA IDENTIFIED AS EITHER OBLIGATE OR FACULTATIVE WETLAND SPECIES POTENTIALLY TO BE FOUND IN THE CNHP SINKHOLE WETLANDS

(Based on those species documented in the nearby Grafton Ponds and the category assigned by the USFWS Wetland Plants of the State of Virginia 1986)

\*rare according to DCR-DNH rare plant list

**OBLIGATE (OBL)** - Taxa always found in wetlands under natural conditions (frequency greater than 99%) but may persist in non-wetlands if planted or in wetlands that have been drained, filled, or otherwise transformed into non-wetlands.

### Trees

*Quercus lyrata*

### Shrubs

*Cephalanthus occidentalis*

*Decodon verticillatus*

*Itea virginica*

*Litsea aestivalis* \*

*Rhododendron viscosum*

*Viburnum nudum*

### Vines

*Smilax laurifolia*

### Herbaceous

*Azolla caroliniana*

*Carex bullata*

*Carex gigantea*

*Carex glaucescens*

*Carex joorii*

*Carex striata* (formerly *C. walteriana*)

*Chelone cuthbertii* \*

*Dulichium arundinaceum*

*Eleocharis obtusa*

*Eleocharis tuberculosa*

*Eragrostis hypnoides*

*Hottonia inflata* \*

*Juncus debilis*

*Juncus repens*

*Lindernia dubia*

*Ludwigia linearis*

*Ludwigia sphaerocarpa*\*

*Myriophyllum pinnatum*

*Panicum rigidulum* var. *pubescens*

*Polygonum hydropiperoides*

*Pontederia cordata*

*Proserpinaca palustris*

### Obligate Herbaceous cont'd

*Proserpinaca pectinata*

*Rhexia mariana*

*Rhexia virginica*

*Rhynchospora capitellata*

*Rhynchospora corniculata*

*Saccharum baldwinii*

*Sparganium americanum*

*Triadenum virginicum*

*Torreyochloa pallida* (*Puccinella pallida* on USFWS list)

*Utricularia biflora*

*Utricularia radiata* -watchlist

*Xyris jupicai*

### Ferns

*Osmunda regalis* var. *spectabilis*

*Woodwardia virginica*

## **FACULTATIVE WETLAND (FACW)**

Taxa usually found in wetlands (67%-99% frequency), but occasionally found in nonwetlands.

+ indicates frequency of occurrence in wetlands is nearer the high end of scale shown above.

- indicates frequency of occurrence in wetlands is nearer the low end of the scale shown above

### **Trees**

*Aronia arbutifolia*

*Magnolia virginiana* (+)

*Quercus laurifolia* (-)

### **Shrubs**

*Leucothoe racemosa*

*Lyonia ligustrina*

*Vaccinium corymbosum* (-)

### **Herbaceous**

*Andropogon glomeratus*

*Bidens frondosa*

*Cyperus erythrorhizos* (+)

*Cyperus pseudovegetatus*

*Diodia virginiana*

*Echinochloa muricata* (+)

*Echinochloa walteri* (+)

*Eupatorium semiserratum*

*Juncus effusus*

*Listera australis*

*Oldenlandia uniflora*

*Panicum dichotomiflorum* (-)

*Panicum verrucosum*

*Rhynchospora inexpansa*

*Saccharum giganteum*

*Scirpus cyperinus* (+)

### **Ferns**

*Osmunda cinnamomea*

*Woodwardia areaolata*

### **Additional Wetland Species of Grafton Ponds with no agreement at Regional level or not included on USFWS list**

*Agalinis purpurea* (Nat.= FACW)

*Carex debilis* (Nat. = FACW,OBL)

*Dichanthelium longiligulatum* (not on list)

*Fimbristylis autumnalis* (Nat. =FACW+, OBL)

*Fimbristylis perpusilla* (not on list)

*Nyssa biflora* (not on list)

*Panicum rigidulum* var. *condensum* (not on list)

*Quercus nigra* (Nat. = FAC, FACW)

*Rhexia nashii* (Nat. = OBL)

*Riccia* sp. ( a liverwort)(not on list) - members  
of this genus characteristically grow in  
summer on soils that have flooded in spring

*Sphagnum cuspidatum* (not on list)

*Sphagnum macrophyllum* \* (not on list)



**APPENDIX B:**  
**LIST OF ANIMAL SPECIES WITHIN THE PONDS**



Appendix B. List of vertebrates and invertebrates observed at each sinkhole pond at Colonial National Historical Park, 1999-2000. 'Taxa Diversity', like species diversity, refers to the number of different taxa represented. It was calculated as the sum of the number of vertebrate species, insect families (Diptera and Ephemeroptera were taken only to order. Odonata were only counted to family, though many species identification were made and are reported here.), and non-insect orders.

o = observed; c = collected.

Order/Class	Species	Common Name	15	42	43	44	45	46	47/48	55	62	63
Fish	<i>Umbra pygmaea</i>	Eastern Mudminnow				o		o	o	o	o	
	<i>Ambystoma opacum</i>	Marbled Salamander	o					o		o		
	<i>Ambystoma mabeei</i>	Mabee's Salamander								c		
	<i>Ambystoma maculatum</i>	Spotted Salamander	o									
	<i>Bufo fowleri</i>	Fowler's Toad								o		
	<i>Hyla cinerea</i>	Green Treefrog				o		o	o	o	o	
	<i>Hyla chrysoscelis</i>	Cope's Gray Treefrog	o			o		o	o			
Amphibians	<i>Notophthalmus viridescens</i>	Red-Spotted Newt	o									
	<i>Rana catesbeiana</i>	American Bullfrog	o					o				
	<i>Rana clamitans</i>	Green Frog	o					o		o	o	
	<i>Rana sphenoccephala</i>	Southern Leopard Frog	o			o		o				
	<i>Rana palustris</i>	Pickerel Frog						o				
	<i>Plethodon cinereus</i>	Red-backed Salamander						o				
	<i>Pseudacris crucifer</i>	Spring Peeper	o			o			o	o		
	<i>Pseudacris feriarum</i>	Southeastern Chorus Frog	o			o			o	o		
Reptiles	<i>Clemmys guttata</i>	Spotted Turtle								o		
	<i>Terrapene carolina</i>	Box Turtle	o									
	<i>Aix sponsa</i>	Wood Duck						o		o		
Birds	<i>Tringa melanoleuca</i>	Greater Yellowlegs		o	o		o					
	<i>Tringa flavipes</i>	Lesser Yellowlegs		o	o		o					
	<i>Charadrius vociferus</i>	Killdeer		o	o		o					
	<i>Ardea herodias</i>	Great Blue Heron	o							o		
<b>Vertebrate Taxa Diversity:</b>			<b>11</b>	<b>3</b>	<b>3</b>	<b>6</b>	<b>3</b>	<b>10</b>	<b>5</b>	<b>11</b>	<b>3</b>	<b>0</b>

Appendix B continued.

Order	Family	Species	15	42	43	44	45	46	47/48	55	62	63
Coleoptera	Curculionidae					c			c			
	Dytiscidae		c			c		c	c	c	c	c
	Elmidae (?)					c			c			
	Hydrophilidae		c					c		c	c	
	Noteridae		c									
	Staphylinidae					c			c			
Diptera			o			o	o	o	o	o	o	o
Ephemeroptera								c	c		c	
Hemiptera	Corixidae		c					c			c	c
	Gerridae		c			c		c	c	c	c	c
	Naucoridae					c						
	Nepidae		c					c		c		
	Notonectidae		c			c		c	c	c	c	c
	Velidae		c							c	c	
Neuroptera	Corydalidae		c									
Odonata	Aeschnidae	<i>Anax junius</i>	c			c		c	o	c	c	
		<i>Epiaeschna heros</i>	o							o		o
		<i>Enallagma sp.</i>				c						
		<i>Enallagma civile</i>	c						o			
	Coenagrionidae	<i>Enallagma aspersum</i>	c									
		<i>Enallagma daeckii</i>	c									
		<i>Ishnura hastata</i>				o			o	c		
		<i>Ishnura posita</i>	o			o			o	o	o	o
	Cordulidae	<i>Epithea cynosura</i>								c	o	o
	Gompidae	<i>Gomphus lividus</i>								c		
		<i>Lestes sp.</i>									c	
	Lestidae	<i>Lestes disjunctus australis</i>	c			c				c		
		<i>Lestes rectangularis</i>	c									
	Libellulidae	<i>Libellula sp.</i>	c									
		<i>Celithemis eponina</i>				o			o			

Order	Family	Species	13/15	42	43	44	45	46	47/48	55	62	63
Odonata	Libellulidae	<i>Libellula axilena</i>	o									
		<i>Libellula deplanata</i>								c		
		<i>Libellula incesta</i>	o									
		<i>Libellula luctuosa</i>							o			
		<i>Libellula lydia</i>				o			o	o		
		<i>Libellula vibrans</i>								c		
		<i>Erythemis simplicicollis</i>	o			c			o	o		
		<i>Pachydiplax longipennis</i>	o			c			o			
		<i>Pantala sp.</i>				o			o			
		<i>Tramea lacerata</i>				o						
Trichoptera	Beraeidae		c					c				
	Hydroptilidae		c									
	Phryganeidae		c					c				
	Polycentropodidae		c					c				
Amphipoda			c			o		o	o	c	c	c
Anostraca			c									c
Cladostera			c									
Decapoda						o		c	o	c	c	o
Isopoda			c			o		c	o	c	c	c
Bivalvia (Fingernail clams)			c					c				
Gastropoda			c					c				
<b>Invertebrate Taxa Diversity (insect families plus non-insect orders):</b>			<b>24</b>	<b>0</b>	<b>0</b>	<b>15</b>	<b>1</b>	<b>17</b>	<b>14</b>	<b>16</b>	<b>15</b>	<b>12</b>
<b>Combined Taxa Diversity (vertebrate plus invertebrate totals):</b>			<b>35</b>	<b>3</b>	<b>3</b>	<b>21</b>	<b>4</b>	<b>27</b>	<b>19</b>	<b>27</b>	<b>18</b>	<b>12</b>

**APPENDIX C:**

**LIST OF ANIMAL SPECIES NOTED AT CNHP DURING THE 1999-2000 SURVEYS**

Appendix C – A list of the animals noted by DCR-DNH biologists during surveys of sinkhole ponds, ravines, and roadside observations on CNHP in 1999 and 2000. These animals are not necessarily associated with sinkhole ponds or ravines. This list is not an exhaustive list of all animal species found on CNHP, nor does it indicate the status of the species (e.g., breeding resident, migrant etc.). ‘MP’ indicates that that species was seen only at the Mount Pleasant ravines near Black Duck Gut.

#### Amphibians

Southern Two-lined salamander- MP

#### Birds

Acadian Flycatcher

American Crow

American Goldfinch

American Robin

Bald Eagle

Barred Owl

Belted Kingfisher

Black-and-white Warbler

Black-capped Chickadee

Blue Grosbeak

Blue-gray Gnatcatcher

Bufflehead

Canada Geese

Carolina Chickadee

Carolina Wren

Chipping Sparrow

Common Grackle

Common Merganser

Double-crested Cormorant – MP

Downy Woodpecker

Eastern Bluebird

Eastern Meadowlark

Eastern Phoebe

Eastern Wood Pewee

European Starling

Field Sparrow

Great Crested Flycatcher

Great Horned Owl- MP

Hairy Woodpecker- MP

Hermit Thrush

Hooded Merganser

Louisiana Waterthrush

Mallard

Mourning Dove- MP

Northern Cardinal – MP

Northern Flicker

Northern Parula

Osprey- MP

Ovenbird

Pileated Woodpecker

Pine Warbler

Purple Martin

Red-bellied Woodpecker

Red-eyed Vireo

Red-headed Woodpecker

Red-shouldered Hawk

Red-tailed Hawk

Red-winged Blackbird

Ring-billed Gull

Scarlet Tanager

Song Sparrow

Summer Tanager

Tree Swallow

Tufted Titmouse

Turkey Vulture

White-breasted Nuthatch

White-eyed Vireo

Wild Turkey (sign)

Wood Thrush

Yellow Warbler

Yellow-billed Cuckoo

Yellow-rumped Warbler

#### Mammals

Fox sp. (sign)

Gray Squirrel

Groundhog

Eastern Cottontail (sign)

White-tailed Deer

#### Reptiles

Black Ratsnake

Eastern Gartersnake- MP

Eastern Wormsnake

Five-lined Skink

Northern Black Racer

Northern Fence-lizard- MP

Northern Red-bellied Cooter

Northern Watersnake

Rough Earthsnake

Rough Greensnake- MP

#### Butterflies

American Lady

Carolina Satyr – MP

Common Buckeye

Appendix B continued.

Butterflies continued

Duskywing sp.  
Eastern Tailed-blue  
Eastern Tiger Swallowtail  
Falcate Orangetip  
Henry's Elfin  
Juvenal's Duskywing  
Least Skipper  
Monarch- MP  
Mourning Cloak  
Orange Sulphur  
Painted Lady  
Pearl Crescent – MP  
Question Mark  
Red Admiral – MP  
Red-banded Hairstreak- MP  
Red-spotted Purple  
Southern Pearly-eye- MP  
Spicebush Swallowtail  
Spring Azure  
Tawny Emperor – MP  
Zebra Swallowtail

Moths

*Abablemma brimleyana* (Dyar)  
*Abagrotis alternata* (Grt.) - MP  
*Acronicta inclara* Sm. complex - MP  
*Agnorisma bollii* (Grt.) - MP  
*Agrotis ipsilon* (Hufn.) - MP  
*Amolita obliqua* Sm.  
*Amphipyra pyramidoides* Gn. - MP  
*Anicla infecta* (Ochs.) - MP  
*Basilodes pepita* Gn. - MP  
*Besma quercivoraria* (Gn.)  
*Bleptina caradrinalis* Gn. - MP  
*Bomolocha abalienalis* (Wlk.)  
*Bomolocha baltimoralis* (Gn.) - MP  
*Bomolocha manalis* (Wlk.) - MP  
*Cabera variolaria* Gn. - MP  
*Caenurgia chloropha* (Hbn.) - MP  
*Calledapteryx dryopterata* Grt.  
*Callopietria mollissima* (Gn.) - MP  
*Catocala piatrix* Grt. - MP  
*Charadra deridens* (Gn.) - MP  
*Choephora fungorum* Grt.&Rob. - MP  
*Chytonix palliatricula* (Gn.) - MP  
*Cisthene packardii* (Grt.) - MP

*Cisthene plumbea* Stretch  
*Clemensia albata* Pack.  
*Cutina albopunctella* (Wlk.) - MP  
*Cutina arcuata* Pogue & Ferguson - MP  
*Cyclophora pendulinaria* (Gn.)  
*Cyclophora packardii* (Prout) - MP  
*Dasylophia anguina* (J.E.Sm.)  
*Dasylophia thyatiroides* (Wlk.)  
*Dryocampa rubicunda* (F.) - MP  
*Elaphria grata* Hbn. - MP  
*Elaphria versicolor* (Grt.)  
*Epimecis hortaria* (F.)  
*Euchlaena obtusaria* (Hbn.)  
*Eudryas grata* (F.)  
*Eulithis diversilineata* (Hbn.) - MP  
*Eulithis gracilineata* (Gn.) - MP  
*Eupithecia miserulata* Grt. - MP  
*Eusarca confusaria* Hbn. - MP  
*Feltia herilis* (Grt.) - MP  
*Glenoides texanaria* (Hulst) - MP  
*Halysidota tessellaris* (J.E.Sm.) - MP  
*Helicoverpa zea* (Boddie) - MP  
*Heterocampa biundata* Wlk. - MP  
*Heterocampa subrotata* Harv.  
*Heterocampa umbrata* Wlk. - MP  
*Holomelina aurantiaca* (Hbn.) - MP  
*Homophoberia apicosa* (Haw.)  
*Hypagyrtis unipunctata* (Haw.)  
*Hypoprepia fucosa* Hbn.  
*Idia aemula* (Hbn.)  
*Idia americalis* (Gn.) - MP  
*Idia rotundalis* (Wlk.)  
*Idia scobialis* (Grt.) - MP  
*Isoparce cupressi* (Bdv.) - MP  
*Lacinipolia implicata* McD. - MP  
*Lapara coniferarum* (J.E.Sm.)  
*Ledaea perditalis* (Wlk.)  
*Lithacodia muscosula* (Gn.)  
*Mocis texana* (Morr.) - MP  
*Nadata gibbosa* (J.E.Sm.) - MP  
*Nemoria bistriaria bistriaria* Hbn. - MP  
*Nephelodes minians* Gn. - MP  
*Oligocentria semirufescens* (Wlk.) - MP  
*Orthonama centrostrigaria* (Woll.) - MP  
*Orthonama obstipata* (F.) - MP  
*Palthis angulalis* (Hbn.)  
*Palthis asopialis* (Gn.) - MP  
*Panopoda carneicosta* Gn. - MP  
*Parallelia bistriaris* Hbn. - MP  
*Parapamea buffaloensis* (Grt.) - MP  
*Phalaenophana pyramusalis* (Wlk.) - MP

*Plathypena scabra* (F.) - MP  
*Probole amicaria* (H.-S.)  
*Prochoerodes transversata* (Dru.) - MP  
*Proxenus miranda* (Grt.) - MP  
*Pseudaletia unipuncta* (Haw.) - MP  
*Pyrrharctia isabella* (J.E.Sm.) - MP  
*Redectis vitrea* (Grt.)  
*Renia discoloralis* Gn. - MP  
*Rivula propinqualis* Gn.  
*Scolecocampa liburna* (Gey.) - MP  
*Scopula limboundata* (Haw.)  
*Semiothisa aequiferaria* (Wlk.) - MP  
*Semiothisa bicolorata* (F.) - MP  
*Semiothisa multilineata* (Pack.) - MP  
*Spilosoma virginica* (F.) - MP  
*Sunira bicolorago* (Gn.) - MP  
*Symmerista albifrons* (J.E.Sm.) complex - MP  
*Tetanolita mynesalis* (Wlk.) - MP  
*Thioptera nigrofimbria* (Gn.) - MP  
*Thysanopyga intractata* (Wlk.)  
*Tricholita signata* (Wlk.) - MP  
*Xanthotype urticaria* Swett - MP  
*Xestia dilucida* (Morr.) - MP  
*Xestia dolosa* Franc. - MP  
*Zale lunata* (Dru.) - MP  
*Zale obliqua* (Gn.) - MP  
*Zanclognatha ochreipennis* (Grt.) - MP

#### Other Invertebrates

Fishing spiders

Wolf spider

Bessbug

Katydid

*Cicindela sexguttata* (a tiger beetle)

*Cicindela punctulata* (a tiger beetle) – MP

*Cicindela repanda* (a tiger beetle) – MP

Ebony Jewelwing

Needham's Skimmer- MP

Twin –spotted Spiketail

**APPENDIX D:**  
**LISTS OF PLANT SPECIES WITHIN THE PONDS**



## Pond 15

	Scientific Name	Common Name	Comments	Wetland Species Status
Trees:	<i>Acer rubrum</i>	red maple		FAC
	<i>Asimina triloba</i>	pawpaw		FACU+
	<i>Diospyros virginiana</i>	persimmon		FAC-
	<i>Ilex opaca</i>	American holly		FACU+
	<i>Liquidambar styraciflua</i>	sweet gum		FAC
	<i>Liriodendron tulipifera</i>	tulip-tree	seedling	FACU
	<i>Nyssa sylvatica</i>	black gum		FAC
	<i>Pinus taeda</i>	loblolly pine		FAC-
	<i>Quercus nigra</i>	water oak		Nat. = FAC, FACW
	<i>Quercus pagoda</i>	cherrybark oak		not on list
	<i>Quercus phellos</i>	willow oak		FAC+
Shrubs:	<i>Leucothoe racemosa</i>	fetterbush		FACW
	<i>Morella cerifera</i> (= <i>Myrica cerifera</i> )	southern bayberry		FAC
	<i>Vaccinium corymbosum</i>	highbush blueberry		FACW-
Vines:	<i>Smilax rotundifolia</i>	common greenbrier		FAC
Herbaceous:	<i>Carex albolutescens</i>	greenish-white sedge		FACW
	<i>Carex cf. complanata</i> <i>Carex jorii</i>	hirsute sedge cypress-swamp sedge	immature	Nat.= FACU-, OBL OBL
	<i>Chasmanthium laxum</i> <i>Mitchella repens</i>	slender spikegrass partridge-berry		FAC FACU
Non-vascular:	<i>Sphagnum cuspidatum</i>	a peat moss	dominant ground cover	a wetland species
TAXA TOTAL:	21			

	Scientific Name	Common Name	Comments	Wetland Species Status
Trees:	<i>Acer rubrum</i>	red maple	seedling	FAC
	<i>Liquidambar styraciflua</i>	sweet gum	seedling	FAC
	<i>Pinus taeda</i>	loblolly pine	young	FAC-
	<i>Pinus virginiana</i>	Virginia pine	seedling	not on list
Herbaceous:	<i>Andropogon virginicus</i>	broomsedge		FACU
	<i>Anthoxanthum odoratum</i>	sweet vernal grass	non-native	Nat.= OBL
	<i>Axonopus furcatus</i>	big carpet grass	watchlist species	
	<i>Carex longii</i>	greenish-white sedge		OBL
	<i>Cynodon dactylon</i>	Bermuda grass	invasive alien	FACU
	<i>Cyperus pseudovegetus</i>	green flatsedge		FACW
	<i>Dichanthelium scoparium</i>	velvet panic grass		FACW
	<i>Diodia virginiana</i>	Virginia buttonweed		FACW
	<i>Duchesnea indica</i>	Indian strawberry	non-native	FACU-
	<i>Echinochloa muricata</i>	rough barnyard grass		FACW+
	<i>var. muricata</i>			
	<i>Eleocharis tenuis</i>		Watchlist species- only seen sterile; need achenes to confirm	
	<i>(cf. var. verrucosa)</i>			
	<i>Eragrostis refracta</i>	coastal lovegrass		FACW
	<i>Eupatorium capillifolium</i>	dog-fennel		FACU-
	<i>Euthamia caroliniana (=E. minor)</i>	small slender goldenrod		FACU
	<i>Fimbristylis autumnalis</i>	slender fimbry		Nat.= FACW+, OBL
	<i>Holcus lanatus</i>	velvet-grass	invasive alien	Nat. =FACU-,FACW
	<i>Hypericum gymnanthum</i>	clasping-leaved St. John's-wort		OBL
	<i>Juncus acuminatus</i>	sharp-fruited rush		OBL
	<i>Juncus biflorus</i>	grass-leaved rush		FACW
	<i>Juncus effusus</i>	soft rush		FACW+
	<i>Juncus scirpoides var. scirpoides</i>	scirpus-like rush		FACW+
	<i>Juncus tenuis</i>	slender rush		FAC-
	<i>Kummerowia striata</i>	Japanese bushclover	non-native	FACU
	<i>(=Lespedeza striata)</i>			
	<i>Lolium pratense (=Festuca elatior)</i>	meadow fescue	invasive alien	Nat.= FACU
	<i>Ludwigia alternifolia</i>	alternate-leaved seedbox		FACW+
	<i>Ludwigia palustris</i>	marsh seedbox		OBL, DRA
	<i>Mecardonia acuminata</i>	purple mecardonia		OBL
	<i>Panicum dichotomiflorum</i>	fall witch grass		FACW-
	<i>Panicum rigidulum var. rigidulum</i>	tall flat panic grass		FACW+

<i>Paspalum laeve</i>	smooth field paspalum		FAC+
<i>Polygala mariana</i>	Maryland milkwort		FACW
<i>Polygonum hydropiperoides</i>	mild water-pepper		OBL
<i>Ranunculus bulbosus</i>	bulbous buttercup	non-native	Nat.=FAC+,FACW
<i>Rhexia mariana</i> var. <i>mariana</i>	Maryland meadow-beauty		OBL
<i>Rhynchospora glomerata</i> var. <i>glomerata</i>	clustered beakrush		OBL
<i>Rumex acetosella</i>	sheep sorrel	invasive alien	Nat. =FACU, FACW
<i>Scirpus</i> sp. (cf. <i>cyperinus</i> )	(cf. woolgrass bulrush)	immature	(FACW+)
<i>Scutellaria integrifolia</i>	hyssop skullcap		FACW
<i>Setaria parviflora</i>	bristly foxtail		FAC
<i>Spiranthes vernalis</i>	twisted ladies'-tresses		FAC
<i>Symphotrichum dumosum</i> (=Aster dumosus)	bushy aster		FAC

TAXA TOTAL 45

	Scientific Name	Common Name	Comments	Wetland Species Status
Trees:	<i>Liquidambar styraciflua</i>	sweet gum	seedling	FAC
Herbaceous:	<i>Andropogon virginicus</i>	broomsedge		FACU
	<i>Anthoxanthum odoratum</i>	sweet vernal grass		FACU
	<i>Axonopus furcatus</i>	big carpet grass	watchlist species	Nat. = OBL
	<i>Carex longii</i>	greenish-white sedge		OBL
	<i>Cynodon dactylon</i>	Bermuda grass	invasive alien	FACU
	<i>Cyperus retrorsus</i>	retorse flatsedge		FAC-NR, Nat. = FAC
	<i>Dichanthelium acuminatum</i> var. <i>fasciculatum</i>	a panic grass		
	<i>Dichondra carolinensis</i>	Carolina pony-foot		FACW
	<i>Diodia virginiana</i>	Virginia buttonweed		FACW
	<i>Duchesnea indica</i>	Indian strawberry	non-native	FACU-
	<i>Eleocharis tenuis</i> (cf. var. <i>verrucosa</i> )	(slender spikerush)	watchlist species - only seen sterile	
	<i>Eragrostis refracta</i>	coastal lovegrass		FACW
	<i>Euthamia</i> sp.	a goldenrod	sterile	
	<i>Kummerowia striata</i> (= <i>Lespedeza striata</i> )	Japanese bushclover	non-native	FACU
	<i>Panicum anceps</i>	panic grass		Nat. = FAC, FACW
	<i>Panicum dichotomiflorum</i>	fall witch grass		FACW-
	<i>Panicum rigidulum</i> var. <i>elongatum</i>	redtop panic grass		FACW+
	<i>Paspalum laeve</i>	smooth field paspalum		FAC+
	<i>Polygonum punctatum</i>	dotted smartweed		OBL
	<i>Polygonum hydropiperoides</i>	mild water-pepper		OBL
	<i>Ranunculus bulbosus</i>	swamp buttercup	non-native	Nat.= FAC+, FACW
	<i>Rhexia mariana</i>	Maryland meadow-beauty		OBL
	<i>Rubus</i> sp.	a bramble	sterile	
	<i>Setaria parviflora</i>	bristly foxtail		FAC
	<i>Solanum carolinense</i>	Carolina horse-nettle		not on list
	<i>Symphotrichum dumosum</i> (= <i>Aster dumosus</i> )	bushy aster		FAC

TAXA TOTAL

27

	Scientific Name	Common Name	Comments	Wetland Species Status
Trees:	<i>Acer rubrum</i>	red maple		FAC
	<i>Asimina triloba</i>	paw paw		FACU+
	<i>Carpinus caroliniana</i>	American hornbeam		FAC
	<i>Fagus grandifolia</i>	American beech	on edge	FACU
	<i>Fraxinus pennsylvanica</i>	green ash		FACW
	<i>Ilex opaca</i>	American holly		FACU+
	<i>Liquidambar styraciflua</i>	sweet gum		FAC
	<i>Liriodendron tulipifera</i>	tulip-tree		FACU
	<i>Nyssa sylvatica</i>	black gum		FAC
	<i>Pinus taeda</i>	loblolly pine		FAC-
	<i>Quercus alba</i>	white oak	on edge	Nat. = FACU, FACU+
	<i>Quercus pagoda</i>	cherrybark oak		not on list
	<i>Quercus phellos</i>	willow oak		FAC+
	<i>Ulmus americana</i>	American elm		FAC
Shrubs:	<i>Vaccinium corymbosum</i>	highbush blueberry		FACW-
Vines:	<i>Campsis radicans</i>	trumpet-creeper		FAC
	<i>Lonicera japonica</i>	Japanese honeysuckle	invasive alien -little seen	FAC-
	<i>Lonicera sempervirens</i>	trumpet honeysuckle		FACU
	<i>Parthenocissus quinquefolia</i>	Virginia creeper		FACU
	<i>Smilax rotundifolia</i>	common greenbrier		FAC
	<i>Toxicodendron radicans</i>	poison ivy		FAC
Herbaceous:	<i>Agrostis perennans</i>	autumn bentgrass		Nat. = FACU, FAC
	<i>Athyrium filix-femina</i>	lady fern		FAC
	<i>Botrychium dissectum</i>	cutleaf grape-fern		FAC
	<i>Carex joorii</i>	cypress-swamp sedge		OBL
	<i>Carex debilis</i> var. <i>debilis</i>	white-edge sedge		Nat. = FACW, OBL
	<i>Carex</i> cf. <i>festucacea</i> (immature)	(fescue sedge)		Nat. = FAC, FACW
	<i>Carex gracillima</i>	graceful sedge		not on list
	<i>Carex lupulina</i>	hop sedge		OBL
	<i>Carex squarrosa</i>	squarrose sedge		FACW
	<i>Carex swanii</i>	swan sedge		not on list
	<i>Chasmanthium laxum</i>	slender spikegrass		FAC
	<i>Cinna arundinacea</i>	wood reedgrass		FACW+
	<i>Dichanthelium commutatum</i>	variable panic grass		FACU+
	<i>Dichanthelium dichotomum</i> var. <i>ensifolium</i>	barbed panic grass		

	<i>Dichanthelium dichotomum</i> (var. 4= <i>ramulosum</i> - not recognized by Kartesz 1999)	small fruited panic grass		FAC
	<i>Euonymus americana</i>	American strawberry bush	on edge	FAC
	<i>Galium obtusum</i> ssp. <i>obtusum</i>	bluntleaf bedstraw		FACW+
	<i>Glyceria striata</i>	fowl mannagrass		OBL
	<i>Hypericum hypericoides</i> ssp. <i>hypericoides</i>	St. Andrew's cross		FAC
	<i>Juncus coriaceus</i>	leathery rush		FACW+
	<i>Juncus effusus</i>	soft rush		FACW+
	<i>Leersia virginica</i>	Virginia cutgrass		FACW
	<i>Lobelia puberula</i>	downy lobelia		FACW-
	<i>Lycopus</i> cf. <i>virginicus</i>	(Virginia bugleweed)		OBL
	<i>Microstegium vimineum</i>	Japanese stilt grass	invasive alien -little seen	FAC
	<i>Mitchella repens</i>			FACU
	<i>Osmunda regalis</i> var. <i>spectabilis</i>	royal fern		OBL
	<i>Panicum rigidulum</i> var. <i>rigidulum</i>	tall flat panic grass		FACW+
	<i>Poa autumnalis</i>	autumn bluegrass		FAC
	<i>Polygonum</i> sp.	(smartweed)	no flower/fruit seen	
	<i>Sphenopholis pensylvanica</i>	swamp wedge grass		Nat. = OBL
	<i>Thelypteris palustris</i> var. <i>pubescens</i>	marsh fern		FACW+
	<i>Woodwardia areolata</i>	netted chain fern		FACW+
Non-vascular:	<i>Sphagnum</i> sp. -	a peat moss	only small patch - not collected.	

TAXA TOTAL 55

	Scientific Name	Common Name	Comments	Wetland Species Status
Trees:	<i>Acer rubrum</i>	red maple	seedling	FAC
	<i>Pinus taeda</i>	loblolly pine	seedling	FAC-
	<i>Liquidambar styraciflua</i>	sweet gum	seedling	FAC
Vines:	<i>Toxicodendron radicans</i>	poison ivy		FAC
Herbaceous:	<i>Agalinis purpurea</i>	large purple false-foxglove		Nat. = FACW
	<i>Agrostis perennans</i>	autumn bentgrass		Nat. = FACU, FAC
	<i>Andropogon virginicus</i>	broomsedge		FACU
	<i>Anthoxanthum odoratum</i>	sweet vernal grass	non-native	FACU-
	<i>Axonopus furcatus</i>	big carpet grass	watchlist	Nat.= OBL
	<i>Carex complanata</i>	hirsute sedge		Nat. = FACU-, OBL
	<i>Carex longii</i>	greenish-white sedge		OBL
	<i>Carex vulpinoidea</i>	fox sedge		OBL
	<i>Cyperus pseudovegetus</i>	green flatsedge		FACW
	<i>Cyperus sp.</i>			
	<i>Dichanthelium acuminatum</i> var. <i>fasciculatum</i>	a panic grass		NR
	<i>Dichanthelium dichotomum</i>	a panic grass		FAC
	<i>Dichanthelium scoparium</i>	velvet panic grass		FACW
	<i>Diodia virginiana</i>	Virginia buttonweed		FACW
	<i>Eleocharis tenuis</i> var. <i>verrucosa</i>	slender spikerush	watchlist	FACW+
	<i>Echinochloa muricata</i> var. <i>muricata</i>	rough barnyard grass		FACW+
	<i>Eupatorium capillifolium</i>	dog-fennel		FACU-
	<i>Eupatorium hyssopifolium</i> var. <i>hyssopifolium</i>	hyssop-leaved thoroughwort		not on list
	<i>Euthamia sp.</i>			
	<i>Galium tinctorium</i> var. <i>tinctorium</i>	stiff marsh bedstraw		OBL
	<i>Holcus lanatus</i>	velvet-grass	invasive alien - common early in season	Nat.= FACU-, FACW
	<i>Hypericum gymnanthum</i>	clasping-leaved St. John's-wort		OBL
	<i>Juncus acuminatus</i>	sharp-fruited rush		OBL
	<i>Juncus biflorus</i>	grass-leaved rush		FACW
	<i>Juncus coriaceus</i>	leathery rush		FACW+
	<i>Juncus effusus</i>	soft rush		FACW+
	<i>Juncus scirpoides</i>	scirpus-like rush		FACW
	<i>Juncus tenuis</i>	slender rush		FAC-
	<i>Kummerowia striata</i> (= <i>Lespedeza striata</i> )	Japanese bushclover	non-native	FACU

<i>Lobelia nuttallii</i>	Nuttall's lobelia		FACW
<i>Lolium pratense</i> (= <i>Festuca elatior</i> )	meadow fescue	invasive alien -little seen	Nat.= FACU
<i>Ludwigia palustris</i>	marsh seedbox		OBL (DRA)
<i>Mecardonia acuminata</i>	purple mecardonia		OBL
<i>Panicum rigidulum</i> var. <i>elongatum</i>	redtop panic grass		FACW+
<i>Panicum rigidulum</i> var. <i>rigidulum</i>	tall flat panic grass		OBL or FACW+
<i>Paspalum dilatatum</i>	dallasgrass		FAC+
<i>Paspalum laeve</i>	field paspalum		FAC+
<i>Phyllanthus caroliniensis</i>	Carolina leaf-flower		Nat. = FAC+
<i>Polygala mariana</i>	Maryland milkwort		FACW
<i>Polygonum hydropiperoides</i>	mild-waterpepper		OBL
<i>Pycnanthemum tenuifolium</i>	narrow-leaved mountain-mint		FACW
<i>Rubus</i> sp.	a bramble		
<i>Rumex conglomeratus</i>	clustered green dock		FAC
<i>Setaria parviflora</i>	bristly foxtail		FAC
<i>Sisyrinchium angustifolium</i>	narrow-leaved blue-eyed-grass		FACW-
<i>Solanum carolinense</i>	Carolina horsenettle		not on list
<i>Spiranthes vernalis</i>	twisted ladies'-tresses		FAC
<i>Symphyotrichum dumosum</i> (= <i>Aster dumosus</i> )	bushy aster		FAC

TAXA TOTAL 51



Pond 55a + b

	Scientific Name	Common Name	Comments	Wetland Species Status
Trees:	<i>Acer rubrum</i>	red maple		FAC
	<i>Asimina triloba</i>	paw paw		FACU+
	<i>Carpinus caroliniana</i>	American hornbeam		FAC
	<i>Ilex opaca</i>	American holly		FACU+
	<i>Liquidambar styraciflua</i>	sweet gum		FAC
	<i>Liriodendron tulipifera</i>	tulip-tree	seedlings	FACU
	<i>Nyssa sylvatica</i>	black gum		FAC
	<i>Oxydendrum arboreum</i>	sourwood		not on list
	<i>Pinus taeda</i>	loblolly pine		FAC-
	<i>Quercus alba</i>	white oak		Nat. =FACU, FACU+
	<i>Quercus nigra</i>	water oak		Nat. =FAC, FACW
	<i>Quercus pagoda</i>	cherrybark oak		not on list
	<i>Quercus phellos</i>	willow oak		FAC+
Shrubs:	<i>Morella cerifera</i>	southern bayberry		FAC
	(= <i>Myrica cerifera</i> )			
	<i>Vaccinium corymbosum</i>	highbush blueberry		(FACW-)
Vines:	<i>Smilax bona-nox</i>	cat brier		FACU
	<i>Smilax rotundifolia</i>	common greenbrier		FAC
	<i>Toxicodendron radicans</i>	poison ivy		FAC
Herbaceous:	<i>Andropogon virginicus</i>	broom-sedge		FACU
	<i>Carex albican</i> var. <i>emmonsii</i>	Emmon's sedge		not on list
	<i>Carex abscondita</i>	thicket sedge		FAC
	<i>Carex complanata</i>	hirsute sedge		Nat.=FACU-,OBL
	<i>Carex debilis</i> var. <i>debilis</i>	white-edge sedge		Nat. =FACW, OBL
	<i>Carex joorii</i>	cypress swamp sedge		OBL
	<i>Carex</i> sp. (immature ovals type)	a sedge		
	<i>Carex swanii</i>	Swan sedge		not on list
	<i>Chasmanthium laxum</i>	slender spikegrass		FAC
	<i>Danthonia spicata</i>	poverty oat-grass		not on list
	<i>Dichanthelium dichotomum</i> var. <i>ensifolium</i>	small-leaved panic grass		FACU
	<i>Juncus dichotomus</i>	forked rush		FAC
	<i>Juncus effusus</i>	soft rush		FACW+
	<i>Listera australis</i>	southern twayblade		FACW
	<i>Mitchella repens</i>	partridge-berry		FACU
	<i>Osmunda regalis</i> var. <i>spectabilis</i>	royal fern		OBL
Non-vascular:	<i>Sphagnum cuspidatum</i>	a peat moss	little	
TAXA TOTAL	35			

## Pond 55c

	Scientific Name	Common Name	Comments	Wetland Species Status
Trees:	<i>Acer rubrum</i>	red maple		FAC
	<i>Asimina triloba</i>	paw paw		FACU+
	<i>Ilex opaca</i>	American holly		FACU+
	<i>Liquidambar styraciflua</i>	sweet gum		FAC
	<i>Nyssa sylvatica</i>	black gum		FAC
	<i>Oxydendrum arboreum</i>	sourwood		not on list
	<i>Pinus taeda</i>	loblolly pine		FAC-
	<i>Quercus alba</i>	white oak		Nat.= FACU, FACU+
Shrubs:	<i>Vaccinium formosum</i>	swamp highbush blueberry		not on list; a species of moist ground
Vines:	<i>Smilax rotundifolia</i>	common greenbrier		FAC
	<i>Toxicodendron radicans</i>	poison ivy		FAC
Herbaceous:	<i>Carex abscondita</i>	thicket sedge		FAC
	<i>Carex albicans</i> var. <i>emmonsii</i>	Emmon's sedge		not on list
	<i>Carex jorii</i>	cypress-swamp sedge		OBL
	<i>Chasmanthium laxum</i>	slender spikegrass		FAC
	<i>Juncus tenuis</i>	slender rush		FAC-
	<i>Listera australis</i>	southern twayblade		FACW
	<i>Mitchella repens</i>	partridge-berry		FACU
	<i>Osmunda regalis</i>	royal fern		OBL
	var. <i>spectabilis</i>			
	<i>Thelypteris palustris</i>	marsh fern		FACW+
	var. <i>pubescens</i>			
Non-vascular:	<i>Sphagnum cuspidatum</i>	a peat moss		
	<i>Sphagnum recurvum</i>	a peat moss		
TAXA TOTAL	22			

## Pond 62

	Scientific Name	Common Name	Comments	Wetland Species Status
Trees:	<i>Acer rubrum</i>	red maple		FAC
	<i>Asimina triloba</i>	paw paw		FACU+
	<i>Diospyros virginiana</i>	persimmon		FAC-
	<i>Ilex opaca</i>	American holly		FACU+
	<i>Liquidambar styraciflua</i>	sweet gum		FAC
	<i>Nyssa sylvatica</i>	black gum		FAC
	<i>Pinus taeda</i>	loblolly pine		FAC-
	<i>Quercus laurifolia</i>	laurel oak		FACW-
	<i>Quercus lyrata</i>	overcup oak		OBL
	<i>Quercus nigra</i>	water oak		NA
	<i>Quercus phellos</i>	willow oak		FAC+
Shrubs:	<i>Leucothoe racemosa</i>	fetterbush		FACW
	<i>Morella cerifera</i> (= <i>Myrica cerifera</i> )	southern bayberry		FAC
	<i>Phoradendron leucarpum</i>	American mistletoe	in canopy	not on list
	<i>Vaccinium corymbosum</i>	highbush blueberry		FACW-
	<i>Vaccinium formosum</i>	swamp highbush blueberry		not on list, but a plant of moist ground
Vines:	<i>Smilax rotundifolia</i>	common greenbrier		FAC
	<i>Carex abscondita</i>	thicket sedge		FAC
	<i>Carex albicans</i> var. <i>emmonsii</i>	Emmon's sedge		not on list
	<i>Carex jorii</i>	cypress-swamp sedge		OBL
Herbaceous:	<i>Chasmanthium laxum</i>	slender spikegrass		FAC
	<i>Erechtites hieraciifolia</i>	fireweed	young	FACU
	<i>Mitchella repens</i>	partridge berry	on hummock at base of tree	FACU
TAXA TOTAL	23			

## Pond 63

	Scientific Name	Common Name	Comments	Wetland Species Status
Trees:	<i>Acer rubrum</i>	red maple		FAC
	<i>Ilex opaca</i>	American Holly		FACU+
	<i>Liquidambar styraciflua</i>	sweet gum		FAC
	<i>Nyssa sylvatica</i>	black gum		FAC
	<i>Pinus taeda</i>	loblolly pine		FAC-
	<i>Quercus laurifolia</i>	laurel oak		FACW-
	<i>Quercus nigra</i>	water oak	outer edge	Nat. = FAC, FACW
	<i>Quercus phellos</i>	willow oak		FAC+
Shrubs:	<i>Gaylussacia baccata</i>	black huckleberry	edge	FACU
	<i>Gaylussacia frondosa</i>	dangle berry	edge	FAC
	<i>Leucothoe racemosa</i>	fetterbush		FACW
	<i>Vaccinium corymbosum</i>	highbush blueberry		FACW-
	<i>Vaccinium formosum</i>	swamp highbush blueberry		Not on list, but a plant of moist ground
Vines:	<i>Smilax rotundifolia</i>	common greenbrier		FAC
Herbaceous:	<i>Carex jorii</i>	cypress-swamp sedge		OBL
	<i>Osmunda regalis</i>	royal fern		OBL
	<i>var. spectabilis</i>			
	<i>Saccharum baldwinii</i>	slender plumegrass		OBL
TAXA TOTAL	17			

**APPENDIX E:**  
**INVASIVE ALIEN PLANT SPECIES IN VIRGINIA**

# Invasive Alien Plant Species in Virginia

Alien plants, also referred to as exotic or non-indigenous species, are plants introduced by people intentionally or accidentally into a region far from their native habitat. For the most part, alien plant species form an important part of our culture and contribute immensely to farming, gardening, landscaping, and soil stabilization. Nevertheless, among thousands of plant species introduced to our area, some have displayed unexpected growth tendencies. Invasive alien plants can reduce native biodiversity and alter ecosystem processes.

While most alien plant species do not persist in the wild, introductions since European settlement have substantially changed the composition of native plant communities throughout North America. Of the estimated twenty-five hundred species of vascular plants that grow in the wild in Virginia, some three hundred and fifty are not native to the state. While many of these are restricted to roadsides and other heavily disturbed sites, others readily invade natural and semi-natural landscapes, degrading native habitat.

Invasive alien plant species typically exhibit the following characteristics:

- ♦ Rapid growth and maturity
- ♦ Prolific seed production
- ♦ Highly successful seed dispersal, germination and colonization
- ♦ Rampant vegetative spread
- ♦ Ability to outcompete native species
- ♦ High cost to remove or control

Invasive alien plants often thrive on disturbed sites. Native plant communities fragmented by human disturbance are most vulnerable to invasion, but the most aggressive species can infest even intact ecosystems. Invasive alien plants are free of natural controls such as insects and disease that keep them in balance in their native habitats. They further threaten biodiversity when they harbor nonnative pathogens, fungi, or other organisms that can decimate native species, as with the chestnut blight.

## About the List

This is an advisory list published by Virginia Department of Conservation and Recreation (VDCR) to warn land managers of potential risks associated with certain plant species known to exhibit invasive behavior in some situations. Detailed criteria for listing and ranking invasive alien plants are used by VDCR Natural Heritage Program and the Virginia Native Plant Society. Cumulative impacts on natural areas, potential to disperse and invade natural landscapes, distribution and abundance, difficulty to manage, and impacts on other species are factors used to rank each species. The Invasive Alien Plant List is periodically reviewed by resource experts, including land managers, nurserymen, landscape architects, horticulturalists, botanists, wildlife biologists, and other conservation partners. The list identifies 115 alien plant species and ranks them according to their potential level of invasiveness. Information on region, soil, and light preferences is also provided.

***Invasiveness Ranking*** Each species on the list is assessed according to its cumulative effects on natural areas and native plant habitats where it typically occurs.

Plants given an “A” exhibit the most invasive tendencies in natural areas and native plant habitats. They may disrupt ecosystem processes, and cause major alterations in plant community composition and structure. They establish readily in natural systems and spread rapidly.

“B” ranked species exhibit moderate invasiveness in natural areas. They may have a minor influence on ecosystem processes, alter plant community composition, and affect plant community structure in at least one layer. They may become dominant in the understory layer without threatening all species found in the community. These species tend to require a minor disturbance to become established and spread moderately.

“C” ranked species generally do not affect ecosystem processes but may alter plant community composition by outcompeting one or more native plant species. They often establish in severely disturbed areas. The disturbance

may be natural or human in origin, such as ice-storm damage, windthrow, or road corridors. “C” ranked species spread slowly or not at all from disturbed sites.

***Regions*** For purposes of this brochure, the state has been divided into three regions. Coastal Plain and Piedmont regions follow conventional boundaries of those physiographic provinces. The western third of the state has been lumped into one region called Mountain.

***Habitat Preferences*** The categories for light and soil requirements are very broad and are meant only to give general indication of habitat preferences for these plants.

# Invasive Alien Plant Species of Virginia

Department of Conservation and Recreation  
Division of Natural Heritage  
217 Governor Street  
Richmond, Virginia 23219  
(804) 786-7951  
<http://www.state.va.us/dnh/>

Virginia Native Plant Society  
Blandy Experimental Farm  
400 Blandy Farm Lane, Unit 2  
Boyce, Virginia 22620  
(540) 837-1600  
<http://www.vnps.org>

June 1999		Key												
This list was developed in a cooperative project between the Virginia Department of Conservation and Recreation's Division of Natural Heritage and the Virginia Native Plant Society		A = High B = Medium C = Low	M = Mountains P = Piedmont C = Coastal			F = Full sun P = Partial sun S = Shade			H = Hydric M = Mesic X = Xeric					
COMMON NAME	SCIENTIFIC NAME	INVASIVENESS			REGION			LIGHT			MOISTURE			
		A	B	C	M	P	C	F	P	S	H	M	X	
TREES														
Black pine	<i>Pinus thunbergii</i>			•			•	•	•			•		
China-berry	<i>Melia azedarach</i>		•			•	•	•	•			•		
Mimosa	<i>Albizia julibrissin</i>			•	•	•	•	•	•			•		
Norway maple	<i>Acer platanoides</i>		•		•	•	•	•	•			•		
Sawtooth oak	<i>Quercus acutissima</i>			•	•			•				•		
Siberian elm	<i>Ulmus pumila</i>			•		•		•	•			•		
Tree-of-heaven	<i>Ailanthus altissima</i>	•			•	•	•	•	•			•		
White mulberry	<i>Morus alba</i>			•	•	•	•	•	•			•		
White poplar	<i>Populus alba</i>		•		•	•	•	•	•			•		
VINES														
Balloon vine	<i>Cardiospermum halicababum</i>		•				•	•				•		
Chinese wisteria	<i>Wisteria sinensis</i>		•			•	•		•	•		•		
English ivy	<i>Hedera helix</i>		•			•	•	•	•	•		•		
Fiveleaf akebia	<i>Akebia quinata</i>		•			•	•	•	•	•		•		
Japanese honeysuckle	<i>Lonicera japonica</i>	•			•	•	•	•	•	•		•		
Japanese hops	<i>Humulus japonicus</i>		•		•	•	•	•	•	•	•	•		
Japanese wisteria	<i>Wisteria floribunda</i>			•			•		•	•		•		
Kudzu vine	<i>Pueraria lobata (P. montana)</i>	•			•	•	•	•	•	•		•		
Oriental bittersweet	<i>Celastrus orbiculatus</i>	•			•	•	•		•	•		•		
Periwinkle	<i>Vinca minor &amp; V. major</i>			•	•	•	•	•	•	•		•		
Porcelain-berry	<i>Ampelopsis brevipedunculata</i>	•				•		•	•	•		•		
SHRUBS														
Amur honeysuckle	<i>Lonicera maackii</i>		•		•	•			•			•		
Autumn olive	<i>Elaeagnus umbellata</i>	•			•	•	•	•	•			•		
Bell's honeysuckle	<i>Lonicera x bella</i>			•	•	•	•	•	•			•		
Blunt-leaved privet	<i>Ligustrum obtusifolium</i>		•			•	•			•		•		
Chinese privet	<i>Ligustrum sinense</i>	•			•	•	•		•	•		•		



Japanese barberry	<i>Berberis thunbergii</i>	•		•	•	•	•	•	•	•	•	•	
Japanese spirea	<i>Spiraea japonica</i>	•		•	•			•	•	•	•		
Linden viburnum	<i>Viburnum dilatatum</i>		•		•		•	•				•	
Morrow's honeysuckle	<i>Lonicera morrowii</i>	•		•	•		•	•	•			•	
Multiflora rose	<i>Rosa multiflora</i>	•		•	•	•	•	•				•	
Russian olive	<i>Elaeagnus angustifolia</i>		•	•	•	•	•	•				•	
Standish's honeysuckle	<i>Lonicera standishii</i>	•		•	•			•	•			•	
Sweet breath of spring	<i>Lonicera fragrantissima</i>		•		•		•	•				•	
Tartarian honeysuckle	<i>Lonicera tatarica</i>		•	•	•		•	•				•	
Thorny elaeagnus	<i>Elaeagnus pungens</i>		•		•	•		•				•	
Wineberry	<i>Rubus phoenicolasius</i>	•		•	•	•		•	•			•	
Winged burning bush	<i>Euonymus alatus</i>	•			•			•	•			•	
Wintercreeper	<i>Euonymus fortunei</i>		•			•		•	•	•	•	•	
HERBACEOUS PLANTS													
Alligator weed	<i>Alternanthera philoxeroides</i>	•				•	•	•		•			
Aneilima	<i>Murdannia keisak</i>	•			•	•	•	•		•			
Asiatic sand sedge	<i>Carex kobomugi</i>	•				•	•	•					•
Beefsteak plant	<i>Perilla frutescens</i>		•	•	•	•		•	•			•	
Bermuda grass	<i>Cynodon dactylon</i>		•	•	•	•	•					•	
Birdsfoot trefoil	<i>Lotus corniculatus</i>		•	•	•	•	•	•				•	•
Brazilian water-weed	<i>Egeria densa</i>		•	•	•	•	•	•		•			
Bristled knotweed	<i>Polygonum cespitosum</i>		•	•	•	•	•	•	•	•	•	•	
Brown knapweed	<i>Centaurea jacea</i>		•	•	•		•	•				•	•
Bugleweed	<i>Ajuga reptans</i>		•	•	•	•	•	•				•	•
Bull-thistle	<i>Cirsium vulgare</i>		•	•	•	•	•	•				•	
Canada bluegrass	<i>Poa compressa</i>		•	•	•	•	•	•	•			•	•
Canada thistle	<i>Cirsium arvense</i>	•		•	•	•	•					•	
Chinese lespedeza	<i>Lespedeza cuneata</i>	•		•	•		•					•	
Chinese yam	<i>Dioscorea batatas</i>	•		•	•	•		•	•			•	
Cogon grass	<i>Imperata cylindrica</i>	•				•		•	•			•	
Common chickweed	<i>Stellaria media</i>		•	•	•	•	•	•	•			•	
Common cocklebur	<i>Xanthium strumarium</i>		•	•	•	•	•	•				•	•
Common dayflower	<i>Commelina communis</i>		•	•	•	•	•	•				•	
Common morning-glory	<i>Ipomoea purpurea</i>		•	•	•	•	•					•	
Common reed	<i>Phragmites australis</i>	•			•	•	•	•		•	•		
Common teasel	<i>Dipsacus sylvestris</i>		•	•	•	•	•			•	•		
Crown-vetch	<i>Coronilla varia</i>		•	•	•	•	•					•	•
Curled dock	<i>Rumex crispus</i>		•	•	•		•					•	•
Cut-leaf teasel	<i>Dipsacus laciniatus</i>		•	•			•					•	
European water-milfoil	<i>Myriophyllum spicatum</i>	•		•	•	•	•			•			
Fennel	<i>Foeniculum vulgare</i>		•		•	•	•			•	•	•	
Field-bindweed	<i>Convolvulus arvensis</i>		•	•	•	•	•					•	
Garlic mustard	<i>Alliaria petiolata</i>	•		•	•		•	•	•			•	
Giant foxtail	<i>Setaria faberi</i>		•		•	•	•	•				•	
Giant reed	<i>Arundo donax</i>		•		•	•	•	•		•	•		
Gill-over-the-ground	<i>Glechoma hederacea</i>		•	•	•	•	•	•	•			•	
Golden bamboo	<i>Phyllostachys aurea</i>		•		•	•	•	•				•	
Hydrilla	<i>Hydrilla verticillata</i>	•				•	•	•		•			
Ivy-leaved morning-glory	<i>Ipomoea hederacea</i>		•	•	•	•	•	•		•	•		
Ivy-leaved speedwell	<i>Veronica herderaefolia</i>		•	•	•	•	•	•	•			•	

[illegible]

**About the List**

DCR Natural Heritage and Virginia Native Plant Society use detailed criteria to assess the invasiveness of a plant. Factors used to rank each species include: cumulative impacts on natural areas; potential to disperse and invade natural landscapes; distribution and abundance; difficulty to manage; and impacts on other species. The list is periodically reviewed and updated by land managers, nurserymen, landscape architects, horticulturalists, botanists, wildlife biologists, and other conservation partners.

**Invasiveness Ranking**

Each species on the list is assessed according to its cumulative effects on natural areas and native plant habitats where it typically occurs.

The A-ranked species exhibit the most invasive tendencies in natural areas and native plant habitats. they may disrupt ecosystem processes and cause major alterations in plant community composition and structure. They establish readily in natural systems and spread rapidly.

The B-ranked species exhibit moderate invasiveness

# Invasive Alien Plant Project

The Virginia Native Plant Society (VNPS) and the Department of Conservation and Recreation (DCR) share a commitment to protect native plant habitats, especially those that support rare, threatened or endangered species. Many alien plants have become aggressive competitors that readily invade natural habitats. Competition between plant species is part of any natural habitat, but introduction of alien species disrupts intricate balances and relationships evolved over millennia between native plants and their communities. Some invasive alien plants are serious agricultural weeds, and some are toxic when consumed by livestock. Other invasive aliens, however, have a decided economic benefit as forage plants and in gardens. Thus, no single easy solution to the problem of invasive alien plants exists. Therefore, VNPS and DCR have combined their resources to confront this little known threat to ecological stability.

## Goals of the Project

Given the complexity of the problems posed by invasive alien plants, VNPS and DCR have set forth the following goals:

***Identify*** alien plant species that have potential to become invasive in Virginia.

***Document*** threats posed by specific invasive alien plant species.

***Educate*** the public about the issue of invasive alien plant species.

***Coordinate*** with other agencies and organizations to identify mutual concerns and develop reasonable solutions to the problem of invasive alien plants.

***Develop*** and use sound practices for control of invasive alien plants in natural areas.

## How You Can Help

- ♦ Use native plant species grown from local stock for conservation and landscaping purposes whenever possible. See our publications on Native Plants for Conservation, Recreation, and Landscaping.
- ♦ When using alien plants, avoid highly invasive species. See the list in this brochure and ask about our fact sheets on specific invasive alien plants, or view them on the DCR Natural Heritage or Virginia Native Plant Society web sites:

<http://www.state.va.us/~dcr/vaher.html>

<http://www.hort.vt.edu/vnps>

- ♦ Support public policies that restrict introduction of invasive alien plants and get involved in organizations that work to protect biodiversity.

**APPENDIX F:**  
**SOIL COLOR DATA**

Appendix F. Soil color data from the ponds included in the 1999-2000 survey at CNHP.

POND #	HUE	COLOR NAME VALUE/CHROMA Dry	COLOR NAME VALUE/CHROMA Moist
15	2.5Y	dark grayish brown 4/2	very dark grayish brown 3/2
44	2.5Y	light brownish gray 6/2	dark grayish brown 4/2
45	2.5Y	light brownish gray 6/2	olive brown 4/3
46	2.5Y	grayish brown 5/2	very dark grayish brown 3/2
47-48	2.5Y	light brownish gray 6/2	dark grayish brown 4/2
55a	2.5Y	light brownish gray 6/2	dark grayish brown 4/2
55b	2.5Y	grayish brown 5/2	dark grayish brown 4/2
55c	2.5Y	grayish brown 5/2	dark grayish brown 4/2
62	2.5Y	grayish brown 5/2	very dark grayish brown 3/2
63	2.5Y	grayish brown 5/2	very dark grayish brown 3/2

**APPENDIX G:**  
**RESULTS OF THE SOIL ANALYSES**

Appendix G. Results of the analyses of the soil collected from the seasonal wetlands included in the Colonial National Historical Park Sinkhole Pond inventory in 1999-2000. All analyses were conducted by Brookside Laboratories, Inc. in Knoxville, Ohio.

	<b>pH</b>	<b>Al_ppm</b>	<b>B_ppm</b>	<b>Ca_ppm</b>	<b>Cu_ppm</b>	<b>Fe_ppm</b>	<b>K_ppm</b>	<b>Mg_ppm</b>	<b>Mn_ppm</b>	<b>Na_ppm</b>	<b>P_ppm</b>	<b>Zn_ppm</b>
<b>POND 15</b>	4.1	989	<0.20	178	0.36	52	14	9	<1	9	38	0.65
<b>POND 44</b>	4.4	1008	0.52	423	0.89	469	30	40	2	16	20	1.44
<b>POND 45</b>	4.5	1013	0.42	182	0.85	372	41	36	5	10	17	6.38
<b>POND 46</b>	4.5	1038	0.32	686	1.11	247	57	50	7	18	54	2.61
<b>POND 4748</b>	4.8	956	0.54	789	0.90	409	33	40	5	12	20	2.59
<b>POND 55a</b>	4.0	849	<0.20	18	0.88	87	11	10	<1	8	26	2.28
<b>POND 55b</b>	4.5	1077	<0.20	38	0.57	146	14	15	1	11	10	1.16
<b>POND 55c</b>	3.7	1027	<0.20	35	0.25	56	11	14	<1	9	21	0.89
<b>POND 62</b>	3.6	1302	< 0.20	91	0.24	38	25	32	< 1	9	29	1.80
<b>POND 63</b>	3.7	1113	< 0.20	74	0.34	37	24	29	< 1	7	27	0.89



**APPENDIX H:**

**GRAFTON PONDS CONSERVATION SITE:  
NATURAL HERITAGE RESOURCES OUTSIDE COLONIAL NATIONAL HISTORICAL PARK**

**APPENDIX I:**  
**MARL RAVINE SURVEYS CONDUCTED IN 2000**

## **MARL RAVINE SURVEYS CONDUCTED IN 2000 IN COLONIAL NATIONAL HISTORICAL PARK**

### **INTRODUCTION**

Due to the smaller number of sinkhole ponds to be intensively surveyed than originally expected, DCR-DNH and CNHP agreed that some field days would be spent during the 2000 field season surveying selected sites of potential marl ravines for rare, threatened, and endangered species and significant natural communities. Other ravine systems on CNHP that are underlain by the lime-rich clay known as marl have been found to support a variety of rare plants, animals, and significant natural communities (Hobson 1998). The two areas to be surveyed included a ravine system north of Hickory Hill and a ravine system near Mount Pleasant, west of the Black Duck Gut tract in Surry County. The National Park System does not own, but holds a conservation easement on the ravines near the Black Duck Gut tract.

### **METHODOLOGY**

More details on the methodology employed in a Natural Heritage inventory for each of the disciplines can be found in the Methods section of the main body of this report.

#### Community Inventory

In late May, the ravine system north of Hickory Hill was visited and a vegetation plot on a marl-influenced forested slope was done on the section southwest of the Parkway. Other sections of this area were visited to assess the quality of the communities present. Three additional vegetation plots were done on July 11 in this marl ravine system. The ravine system west of Black Duck Gut, near Mount Pleasant, was visited in late May to conduct a general survey to evaluate the area for community vegetation work to be done later in the field season. On July 18, the ravine system near Mount Pleasant was visited and two vegetation plots were done.

#### Zoological Inventory

Methods for the zoological surveys were primarily hand collection of seepage fauna, visual observation, and sweepnet collection. A survey for amphipods was conducted in early April in the ravines north of Hickory Hill and northwest of Yorktown National Cemetery. Two visits were made to the Mount Pleasant ravine system near Black Duck Gut. The first trip in mid-August, entailed setting two UV-light traps overnight in the bald cypress forest for the collection of nocturnal insects. The second trip in early October focused on surveying for groundwater amphipods and other invertebrates associated with seepage habitat.

#### Botanical Inventory

The ravines and slopes north of Hickory Hill, both northeast and southwest of the Parkway, were visited in late April to search for Virginia least trillium (*Trillium pusillum* var. *virginiana*) (G3T2/S2) and sweet pinesap (*Monotropsis odorata*) (G3/S2S3) and do a general reconnaissance. In late May, the ravine system near Mount Pleasant was visited also to survey for Virginia least trillium. A visit was made to the Mount Pleasant Ravines site on May 8, 2001, to determine the identity of a lady's-slipper (*Cypripedium* sp.) observed in a vegetative form in 2000.

### **RESULTS**

#### Community Inventory

Significant natural communities documented in the Hickory Hill Ravine site include Basic Mesic Forest and Coastal Plain Basic Seepage Swamp. This ravine also supports a Mesic Mixed Hardwood Forest which is not considered significant, but is of good quality. The Mount Pleasant site supports a significant

Coastal Plain Basic Seepage Swamp. General information on these community types follow. Plot forms are contained in Appendix J.

#### Basic Mesic Forests

Mixed hardwood forests of fertile, mesic, low-elevation habitats in the Coastal Plain, Piedmont and major mountain valleys. Typical sites are deep ravines, sheltered north- or east-facing slopes subtending large streams and rivers, and occasionally well-drained floodplain terraces. Soils are usually weathered from carbonate or mafic bedrock, or from calcareous, shell-rich deposits in the Coastal Plain. Dominant trees can include tulip-poplar (*Liriodendron tulipifera*), basswoods (*Tilia americana* var. *americana* and var. *heterophylla*), and white ash (*Fraxinus americana*), as well as chinkapin oak (*Quercus muhlenbergii*), black maple (*Acer nigrum*), southern sugar maple (*Acer barbatum*), American beech (*Fagus grandifolia*), bitternut hickory (*Carya cordiformis*), and black walnut (*Juglans nigra*). Shrub and herb layers contain a number of species that are atypical of mountain slopes, such as paw-paw (*Asimina triloba*), twinleaf (*Jeffersonia diphylla*), harbinger-of-spring (*Erigenia bulbosa*), and toadshade (*Trillium sessile*). Several distinctive community types appear to be represented in this group in Virginia, including a river-slope unit of the Piedmont and northern mountains, a river-slope unit of southwestern Virginia carbonate rock districts, a foothill/low mountain unit, and a Coastal Plain calcareous ravine unit. The extent and viability of basic mesic forests has been much reduced by repeated logging and invasive exotic weeds.

References: Fleming (1999), Rawinski *et al.* (1996), Vanderhorst (2000), Ware and Ware (1992).

#### Coastal Plain Basic Seepage Swamps

Saturated deciduous forests occurring in the bottoms of Coastal Plain ravines that have downcut into Tertiary shell deposits or limesands. These are naturally rare, small-patch communities known from the dissected inner Coastal Plain of Surry, Isle of Wight, York, and James City Counties. There is at least one outlying occurrence in Lancaster County. Habitats consist of mucky, braided ravines bottoms saturated by constant groundwater seepage, and soils with high base status. Hummock-and-hollow microtopography is prevalent, and exposed shells are common in springs and rills. Green ash (*Fraxinus pennsylvanica*), red maple (*Acer rubrum*), and tulip-poplar (*Liriodendron tulipifera*) are common canopy trees in most occurrences, but a subset of ravines on the south side of the James River features the unusual co-dominance of bald cypress (*Taxodium distichum*). Small trees and shrubs include stiff dogwood (*Cornus foemina*), spicebush (*Lindera benzoin*), and southern bayberry (*Myrica cerifera*). A number of remarkable mountain disjuncts have been documented in the herbaceous flora of these communities, including marsh-marigold (*Caltha palustris*), rigid sedge (*Carex tetanica*), Kentucky lady-slipper (*Cypripedium kentuckiense*; state-rare), bog twayblade (*Liparis loeselii*; state-rare), swamp lousewort (*Pedicularis lanceolata*), and American false-hellebore (*Veratrum viride*). Reaching their northern limits are the southern species Florida adder's-mouth (*Malaxis spicata*), shadow-witch orchid (*Ponthieva racemosa*), and drooping bulrush (*Scirpus lineatus*). Other characteristic herbs include lizard's-tail (*Saururus cernuus*), golden ragwort (*Senecio aureus*), blackfruit clearweed (*Pilea fontana*), smooth bur-marigold (*Bidens laevis*), Carolina buttercup (*Ranunculus hispidus* var. *nitidus*), brome sedge (*Carex bromoides*), and wood reedgrass (*Cinna arundinacea*). The damp, fertile habitats are particularly susceptible to invasion by the exotic grass Japanese stilt grass (*Microstegium vimineum*). The globally rare Tidewater interstitial amphipod (*Stygobromus araeus*) appears to be closely associated with groundwater in shell marl deposits. Communities in this group are not well documented or protected and should be high priorities for future inventory and conservation.

#### Mesic Mixed Hardwood Forests

Mixed hardwood forests of mesic to submesic, infertile habitats throughout the Coastal Plain and Piedmont, and more locally at low elevations in the mountains. Forests in this group occupy mesic uplands, ravines, lower slopes, and well-drained "flatwoods" on acidic, relatively nutrient-poor soils. The most typical tree canopies contain mixtures of American beech (*Fagus grandifolia*), oaks (*Quercus* spp.,

varying by region), tulip-poplar (*Liriodendron tulipifera*), and hickories (*Carya* spp.), but a wide variety of hardwood associates occur. American hornbeam (*Carpinus caroliniana* ssp. *caroliniana* and ssp. *virginiana*), flowering dogwood (*Cornus florida*) and, in eastern Virginia, American holly (*Ilex opaca* var. *opaca*) are prominent understory plants. In mesic “flatwoods” of the southeastern Virginia Coastal Plain, silky camelia (*Stewartia malacodendron*) and big-leaf snowbell (*Styrax grandifolia*) are characteristic small trees. These communities lack the lush herbaceous layers of rich mixed hardwood forests, although herbaceous species such as Christmas fern (*Polystichum acrostichoides*) may form moderately dense clumps. The name “Southern Mixed Hardwood Forest” has often been applied to Coastal Plain representatives of this group. Although mesic mixed hardwood forests still cover sizeable areas east of the mountains in Virginia, their quality and extent has been reduced by repeated logging. Several distinct community types are represented in this widespread group. References: Coulling (1999), Crouch (1990), DeWitt and Ware (1979), Frost and Musselman (1987), McCoy and Fleming (2000), Monette and Ware (1983), Plunkett and Hall (1995), Ware (1970), Ware (1978), Ware (1991), Wolff and Ware (1994).

#### Zoological Inventory

The globally rare Tidewater interstitial amphipod (*Stygobromus araeus*) G2/S2 was found from a groundwater seep in the ravines north of Hickory Hill on 6 April 2000. This amphipod is known from other marl ravines in the area and from CNHP (Hobson 1998). This species is considered a species of concern in the Commonwealth. In addition, the watchlist amphipod species, Northern spring amphipod (*Gammarus pseudolimneaus*)(G5/S3), was found at four sampling points within the ravine. This species is relatively common in suitable habitats in the vicinity of CNHP and has been previously documented in CNHP (Belden et al. 1995).

The state rare moth, cypress sphinx (*Isoparce compressi*) ( G4/S1S3) was collected from the Mount Pleasant Ravines site. This moth uses bald cypress (*Taxodium distichum*) as a food plant during its larval stage. This is only the third known locality for this species in Virginia.

#### Botanical Inventory

The field botanist found no plant rarities in the early season field visit to the Hickory Hill Ravine site. In a later site visit however, the ecologists, while conducting the inventory for significant communities, found 15 individuals of the state rare plant hoary skullcap (*Scutellaria incana*) (G5/S2) at the bottom of an east-facing calcareous slope in the ravine west of the Parkway and northeast of Hickory Hill. At the Mount Pleasant Ravines site in Surry County west of the Black Duck Gut tract, no Virginia least trillium was found. A *Cypripedium* sp. in very late flower was found in late May 2000; but without the mature flowers, an identification could not be made. Examination of vegetative characters on a later visit by the ecologists also proved inconclusive as to whether this lady’s slipper is the rare Kentucky lady’s slipper (*Cypripedium kentuckiense*) (G3/S1), currently found in only one other location in Virginia, or if it is the more common large yellow lady’s slipper (*Cypripedium parviflorum* var. *pubescens*). On a visit conducted May 8, 2001, when flowering plants were present, it was determined to be the more common *C. parviflorum* var. *pubescens*.

## HICKORY HILL RAVINE

**Size:** Ca. 162 acres

**Biodiversity Rank:** B2

**Locality:** York County, VA

**Quadrangle:** Yorktown

**Quadrangle Code:** 3707625

**Location:** Ravine system north of Hickory Hill and southwest of the Parkway proper, within Colonial National Historical Park.

### NATURAL HERITAGE RESOURCES SUMMARY TABLE

ELEMENT NAME	GLOBAL RARITY RANKS	STATE RARITY RANKS	USFWS STATUS	VA LEGAL STATUS	ELEMENT OCCURRENCE RANK
<b>COMMUNITIES:</b>					
Basic Mesic Forest	G2?	S1	-	-	B
Coastal Plain Basic Seepage Swamp	G2?	S1	-		A
<b>ANIMALS:</b>					
<i>Stygobromus araeus</i> (Tidewater interstitial amphipod)	G2	S2		(SC)	E
<b>PLANTS:</b>					
<i>Scutellaria incana</i> (hoary skullcap)	G5	S2	-	-	D

**Site Description:** This site, located south and west of the Parkway, consists of a marl ravine system and associated uplands. Two significant communities were identified: the Basic Mesic Forest on the slopes and a Coastal Plain Basic Seepage Swamp on the ravine bottom. A small population of the state rare plant species hoary-skullcap (*Scutellaria incana*) was found at the bottom of an east-facing calcareous slope and the tidewater interstitial amphipod (*Stygobromus araeus*) was found in a groundwater seep on the west side of the ravine. The site is bounded by roads and a residential development exists in the uplands on the south side.

**Boundary Justification:** The boundary includes habitat for the rare species and the significant communities and the watershed for surface flow within the site. However, the groundwater recharge zone for this ravine is unknown, and future hydrological studies could result in modification of this boundary. Protection of the watershed for this site is particularly critical for the seepage swamp community and the rare amphipod.

**Threats:** This ravine may already be impacted by adjacent upland development, which includes Hickory Hill to the southeast, a trailer park, and a highway to the west.

**Management Recommendations:** Management of the ravine should minimize impacts from forestry activity or other development that might alter ground water hydrology in the area, increase sedimentation, or destroy the seeps. Further surveys are recommended to determine the population size and persistence of the rare amphipod. Periodic monitoring of the rarities and the significant communities and the water quality within the site is recommended. Hydrological studies are needed to determine the groundwater recharge zone and allow management to focus protection efforts on the threats that would affect the site and its Natural Heritage Resources.

**Protection Recommendations:** Protection measures should include the implementation of management recommendations and consultation with DCR-DNH when changes in land use or management practices are contemplated. CNHP should seek cooperation with adjacent private landowners to protect the site and its Natural Heritage Resources. The Conservation Planning Boundary should be formally incorporated into the planning and management documents for Colonial National Historical Park.

**References:**

## MOUNT PLEASANT RAVINES

**Size:** Ca. 350 acres

**Biodiversity Rank:** B2

**Locality:** Surry County, VA

**Quadrangle:** Surry

**Quadrangle Code:** 3707627

**Location** Ravine system on the south side of the James River, north of Rt. 610, east and south of Mount Pleasant, and west of Colonial National Historical Park's Black Duck Gut tract.

### NATURAL HERITAGE RESOURCES SUMMARY TABLE

ELEMENT NAME	GLOBAL RARITY RANKS	STATE RARITY RANKS	USFWS STATUS	VA LEGAL STATUS	ELEMENT OCCURRENCE RANK
<b>COMMUNITIES:</b>					
Coastal Plain Basic Seepage Swamp	G2?	S1	-	-	B
<b>ANIMALS:</b>					
<i>Isoparce compressi</i> (cypress sphinx)	G4	S2S4	-	-	E
<b>PLANTS:</b>					
None					

**Site Description:** This marl ravine system, located on the south side of the James River west of the Black Duck Gut tract, contains a significant community on the ravine bottom, identified as a Coastal Plain Basic Seepage Swamp, dominated in the canopy by baldcypress (*Taxodium distichum*) and green ash (*Fraxinus pennsylvanica*). A state rare moth, cypress sphinx (*Isoparce compressi*), which feeds on baldcypress in its larval stage, was collected within the ravine bottom community. A lady's slipper (*Cypripedium* sp. ) observed scattered within the seepage community, but which was past flowering during the 2000 inventory, was investigated in early May 2001 and determined to be the more common large lady's-slipper (*Cypripedium parviflorum* var. *pubescens*) rather than the rare Kentucky lady's-slipper (*Cypripedium kentuckiense*). The slopes supported patches of Basic Mesic Forest, not well developed enough to be significant, and Mesic Mixed Forest, not considered to be a significant community. Detailed descriptions of the communities mentioned here are included in the Results. Section of Appendix I. Forests of the slopes and uplands were younger than the ravine bottom, being subjected to past timber harvests. Disturbed areas with prevalent weedy species were noted in the upper portion of the westernmost ravine and in the eastern ravine. The level upland contains agricultural lands and a home site (Mount Pleasant). A conservation easement on this site is held by Colonial National Historical Park.

**Boundary Justification:** The boundary includes the watershed for surface water flow within the site, to protect the rare species habitat and community from upland disturbances that could promote sedimentation and hydrological disturbances. The groundwater recharge zone is unknown, however, and future hydrological studies could result in modification of the boundary. Roads in the upland are included



within the site as runoff from them could contain contaminants that would be detrimental to groundwater quality.

**Threats:** Two highly invasive alien plant species were noted on the ravine bottom. *Aneilima* (*Murdannia keisak*) was prominent in a disturbed upper ravine bottom area and Japanese stilt grass (*Microstegium vimineum*) was present in the seepage swamp community, being particularly prevalent in the eastern ravine. Other disturbances to the canopy in the ravine bottom could promote the spread of these highly invasive species, to the detriment of native herbaceous species diversity. It is unknown if there are any agricultural practices in the upland, (such as herbicide or pesticide use), that could threaten the community and rare moth species.

**Management Recommendations:** Water quality and forest integrity should be maintained by restricting or limiting activities such as timber harvesting in the uplands that could promote erosion from the slopes and the resulting sedimentation within the seepage. Management for the cypress sphinx moth would include maintaining the dynamics of the baldcypress habitat and limiting the use of herbicides and pesticides. Periodic monitoring of the cypress sphinx population and the status of the community is recommended. Invasive alien plant species within the site, particularly within the seepage swamp community should be assessed and, if feasible, action taken to control them. More surveys and investigations are needed to clarify the life history and habitat needs of the cypress sphinx moth.

**Protection Recommendations:** Protection measures should include the implementation of management recommendations and consultation with DCR-DNH when changes in land use or management practices are contemplated. The Conservation Planning Boundary should be formally incorporated into the planning and management documents for Colonial National Historical Park. Ownership of the land changed during 2000 after the inventory; the new owners should be apprised of the significance of the site and CNHP should work with the owners to protect the site.

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